REPORT RESUMES

ED 014 154 08 EA 000 878

SEMINAR ON THE ECONOMICS OF EDUCATION--INVESTMENT DECISIONS AND CONTRIBUTIONS TO INCOME AND ECONOMIC GROWTH. FINAL REPORT.

BY- HANSEN, W. LEE WEISBROD, BURTON A.
WISCONSIN UNIV., MADISON
REPORT NUMBER BR-6-8224 PUB DATE AUG 67
GRANT OEG-3-6-068224-0558
EDRS PRICE MF-$1.50 HC-$14.08 350P.

DESCRIPTORS- HUMAN RESOURCES, *HUMAN CAPITAL, WORKSHOPS, COURSE CONTENT, *ECONOMICS, *INVESTMENT, INCOME, *ECONOMIC DEVELOPMENT, *EDUCATIONAL RESEARCH, SPEECHES, STUDENT PROJECTS, GRADUATE STUDY, ECONOMIC RESEARCH, STUDENT SEMINARS, MADISON,

A WORKSHOP ON THE ECONOMICS OF HUMAN RESOURCES WAS INITIATED IN 1966 AT THE UNIVERSITY OF WISCONSIN TO PROVIDE A VEHICLE FOR STIMULATING RESEARCH BY BOTH FACULTY AND GRADUATE STUDENTS AND TO PROVIDE A MEDIUM FOR DISSEMINATING THE LATEST RESEARCH FINDINGS OF OUTSIDE SCHOLARS, UNIVERSITY OF WISCONSIN FACULTY, AND GRADUATE STUDENTS. THIS DOCUMENT IS A COLLECTION OF THE WORKSHOP'S CONTENTS WHICH INCLUDES PAPERS BY NINE NOTED SPEAKERS--THOMAS FOX, "THE PRODUCTION FUNCTION OF EDUCATION," MARK BLAUG, "THE RATE OF RETURN OF INVESTMENT IN EDUCATION IN BRITAIN," T. W. SCHULTZ, "RESPONSES OF SCHOOLS AND STUDENTS TO ECONOMIC GROWTH," EDWARD F. DENISON, "EDUCATION AND ECONOMIC GROWTH IN NINE EUROPEAN COUNTRIES, 1950-65," HARRY G. JOHNSON, "THE ECONOMICS OF THE BRAIN DRAIN," SAMUEL BOWLES, "AN EDUCATIONAL PLANNING MODEL FOR NORTHERN RHODESIA," DANIEL C. ROGERS, "EDUCATION AND EARNINGS--A CASE STUDY," FINIS R. WELCH, "LABOR MARKET DISCRIMINATION--AN INTERPRETATION OF INCOME DIFFERENCES IN THE RURAL SOUTH," AND MELVIN W. REDER, "INCOMES AND MOBILITY OF DENTISTS." (HW)

BR 6-8224
P.A. 08

ED014154

EA 000 878

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

FINAL REPORT
Project No. 6-8224
Grant No. OEG-3-6-068224-0558

SEMINAR ON THE ECONOMICS OF EDUCATION: INVESTMENT DECISIONS AND CONTRIBUTIONS TO INCOME AND ECONOMIC GROWTH

ED 010 057

August, 1967

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
Bureau of Research

SEMINAR ON THE ECONOMICS OF EDUCATION: INVESTMENT DECISIONS AND CONTRIBUTIONS TO INCOME AND ECONOMIC GROWTH

Project No. 6-8224
Grant No. OEG-3-6-068224-0558

W. Lee Hansen
Burton A. Weisbrod

August, 1967

The research reported herein was performed pursuant to a grant with the Office of Education, U. S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

University of Wisconsin

Madison, Wisconsin

TABLE OF CONTENTS

Final Report

Appendix A

- Announcement - Workshop on Economics of Human Resources

Appendix B

- Suggested Topics for Research
- 101 Questions for Investigation, Willard Thorp

Appendix C

- Student Proposals
  - Don DeVoretz
  - Peter Lundt
  - John L. Melder
  - Michael Oatey
  - Marjorie Putz
  - James Wilson

Appendix D

- Selected Papers of Outside Speakers
  - T. W. Schultz, University of Chicago
  - E. F. Denison, Brookings Institution
  - Daniel C. Rogers, Yale University

Appendix E

- Reading List

Appendix F

- Written Comments of Discussants

Appendix G

- Student Papers
  - Don DeVoretz
  - Peter Lundt
  - John L. Melder
  - Michael Oatey
  - Allen V. Potts

INTRODUCTION

The economics of human resources is a relatively new field, and presents a wide area for research and development. In an attempt to train younger people for work in the rapidly growing areas of the economics of human resources and the economics of education, a Workshop on the Economics of Human Resources was instituted during the spring semester of 1965-66 and the fall semester of 1966-67 at the University of Wisconsin, (see Appendix A).

Graduate students enrolling in the Workshop were afforded an opportunity both to hear lectures from leading researchers and teachers in the field and to initiate research of their own.

METHOD

The Workshop was offered for graduate credit. It met weekly throughout the two semesters. The emphasis in the first semester was on the visits of outside speakers, who presented papers on research they were conducting. Participants in the Workshop also were required during the first semester to select research topics for their own papers, with guidance by the Workshop Directors. Occasional discussion sessions were held to relate the topics covered at the various sessions. A list of research topics developed by the Workshop Directors is included as Appendix B, along with a list prepared by Willard Thorp.

Students were required midway through the first semester to submit proposals outlining their research plans; these were then criticized by the Directors before further work was undertaken. Each student presented a short oral report on his work late in the spring. Copies of the proposals are attached as Appendix C.

The schedule for the first semester of the Workshop was:

February 9	Organizational Meeting
February 16	Thomas Fox, Syracuse University, "The Production Function of Education."
February 22	Mark Blaug, London School of Economics, "The Rate of Return on Investment in Education in Britain."
February 28	T. W. Schultz, University of Chicago, "Responses of Schools and Students to Economic Growth."
March 9	Edward F. Denison, The Brookings Institution, "Education and Economic Growth in Nine European Countries, 1950-65."

March 15	Discussion and Analysis of Papers to Date.
March 22	Discussion and Analysis.
March 30	Harry G. Johnson, University of Chicago, "The Economics of the Brain Drain."
April 6	Discussion of Preliminary Research Proposals by Students.
May 4	Student Reports.
May 11	Samuel Bowles, Harvard University Center for International Affairs, "An Educational Planning Model for Northern Rhodesia."
May 18	Concluding Session.

During the second semester of the Workshop, the primary emphasis was on discussions of the student's research projects, which had begun in the spring semester and continued through the summer. Three additional outside speakers were brought to the campus in the fall. They were:

November 7	Daniel C. Rogers, Yale University, "Education and Earnings: A Case Study."
November 28	Finis R. Welch, Southern Methodist University, "Labor Market Discrimination: An Interpretation of Income Differences in the Rural South."
December 12	Melvin W. Reder, Stanford University, "Incomes and Mobility of Dentists."

A selection of papers presented by visiting speakers is included as Appendix D.

As background for the Workshop, students used as a reading list (Appendix E), a basic bibliography in the human resource area which some of the students had covered in a previous course in Human Resources and Economic Growth. As often as possible, speakers provided advance copies of their papers, so that Workshop participants were familiar with them when presented.

For the sessions devoted to discussion and analysis, a student was assigned to be a formal discussant for each speaker's paper. A written report was prepared by the discussant and subsequently was distributed to the other participants. (See Appendix F.)

RESULTS

Enrollment was limited by the Workshop Directors in order to allow the fullest possible discussion of the research projects and the maximum flow of ideas between the outside speakers and the Workshop participants.

The Workshop sessions at which speakers appeared were open to other faculty and students from the University, but visitors were asked to defer to participants during the discussions and, in some cases, closed meetings were held to further facilitate this exchange.

During the first semester, eight graduate students enrolled in the Workshop for credit, six of them from the Department of Economics and two from the School of Education. In addition, there were three auditors. In the second semester, six students took the Workshop for credit.

Student topics included the following:

Marjorie Putz	"A Survey of Alternative Input Mixes in Teaching."
John Bowman	"The Correlation Between Education and Unemployment." (Not Completed)
Don J. DeVoretz,	"Linear Programming and Educational Investment."
Peter A. Lundt	"The Factor Proportions of Canadian Foreign Trade and Human Capital."
John L. Melder	"Education and Income Redistribution."
M. J. Oatey	"Institutional and On-The-Job Training."
J. A. Wilson	"Time/Cost Trade-Offs and Educational Flexibility." (Not Completed)
Allen V. Potts	"History of Education Benefits Under the Wisconsin State GI Bill of Rights."

Copies of the student papers are included as Appendix G.

DISCUSSION

As stated above, the primary purpose of the Workshop was to stimulate interest and research in the field of human resources.

For the graduate students involved the Workshop presented them with the first hard look at the problems of doing research in the field. In some cases, the initial research topic was changed, or narrowed, or broadened. In all cases, students gained experience in formulating a research topic, designing the research methodology, and in actually doing research in a new field.

As an outgrowth of the Workshop, M. J. Oatey went on to write a Master's Degree thesis dealing with on-the-job training. John L. Melder is presently engaged in research for a dissertation dealing with the variables affecting continuation of students' education after high school. Allen Van Potts is doing research in the field of variable tuition rates, and is revising his Workshop paper for publication. Don DeVoretz is using a linear programming model in assessing the education system of the Philippine Islands, using a methodology similar to that used in his Workshop paper; DeVoretz currently holds a fellowship and is in the Philippines. Thus, the Workshop has stimulated considerable research in the field of human resources.

The value of having outside speakers redounded to others in addition to the Workshop participants since each Workshop session was attended by faculty and other graduate students interested in a particular speaker's research.

The spring-summer-fall format of the Workshop proved to be useful, providing more time for students to complete their work than the usual fall-spring format provides. The difficulty with the approach lies in obtaining financial support for students during the summer, so that they can continue to carry on their research. Unfortunately, we did not ask for such support in our proposal. Were we to submit a proposal such as this again, we would regard the provision for summer research support for student participants as essential.

CONCLUSION

Discussion between outside speakers and Workshop participants proved particularly valuable in opening new lines of thought on questions under consideration and in showing students new ways of approaching complex issues.

At the close of the Workshop, it was decided that a one-semester offering would probably be sufficient to meet the goals of the course, unless we could be assured of having summer financing for the Workshop students. A one-semester Workshop on Human Resources was inaugurated in the fall, 1967, semester.

The investigators feel the Workshop provided a valuable means of bringing new people into the field and stimulating new research activities. This view is supported by the fact that the Workshop is continuing to receive support from a non-government source.

SUMMARY

The Workshop on the Economics of Human Resources was initiated in 1966 at the University of Wisconsin to provide a vehicle for stimulating research by both faculty and graduate students, and to provide a medium for disseminating the latest research findings of outside scholars, University of Wisconsin faculty, and graduate students.

The Workshop ran for two semesters and carried graduate credit. It was held during the spring and fall semesters so that participants could use the summer to carry out their research projects started in the spring semester.

Nine outside speakers, each well-known in the area, presented papers. At the close of the year, each participant completed a paper on a research topic which had been discussed and approved during the year.

Appendix A

Announcement - Workshop on Economics of Human Resources

UNIVERSITY OF WISCONSIN
Department of Economics

ANNOUNCEMENT

WORKSHOP ON ECONOMICS OF HUMAN RESOURCES (ECONOMICS 968-969; also Ed. Pol. Studies 968-969).

Spring-Fall 1966. Professors W. Lee Hansen and Burton A. Weisbrod

A new workshop will be offered during the Spring and continuing into the Fall semester, under the direction of Professors W. Lee Hansen and Burton A. Weisbrod. The objective of the two-semester workshop is to stimulate research in the rapidly-developing area of the economics of human resources. The workshop will, in its first year, focus on the economics of education. In subsequent years, topics to be investigated may include health, mobility, welfare, etc.

The workshop will meet weekly during the spring semester and the following fall semester of each year. During the spring the principal emphasis will be on exposing the participants to new research developments and discussions of future research possibilities; this will be done by the directors of the workshop and will be supplemented by outside speakers. Among the major topics to be taken up this year are: (1) Investment in Man and Economic Growth; (2) Outputs of Education and Their Benefits; (3) Inputs to Education and Their Costs; (4) The Production Function for Education.

In the fall semester, some of the new work stimulated by the workshop -- begun during the first semester and continued over the summer -- should be far enough along to be reported to the workshop and thereby subjected to appraisal and constructive criticism. Thus, during the fall semester the emphasis will be on obtaining progress reports about, and developing critical, analytical discussions of, the research initiated by workshop participants.

Members of the workshop will be required to participate during both semesters. They will also be required to present a carefully-written research prospectus for approval as early as possible but in no case later than the end of the spring semester. Members of the workshop will be urged to undertake research having empirical and quantitative aspects. It is hoped that much of the research will lead to Ph.D. dissertations and/or published papers.

The workshop, which will offer graduate credit, should be of particular interest to students of economic growth, labor theory, public finance and applied welfare economics. Enrollment requires consent of one of the instructors.

Appendix B

Suggested Topics for Research

101 Questions for Investigation (Thorp)

March 1966

Workshop on the Economics of Human Resources
Professors W. Lee Hansen and Burton A. Weisbrod

Suggested topics for research

1. How can we measure the outputs of education? What are the outputs? How do these outputs vary by level of schooling, type of schooling, type of curriculum, by region, etc? Do the forms of output change over time?

2. What are the various types of inputs to the educational process? How can these be identified and quantified? How do these vary by type of schooling, etc? How have they changed over time?

3. What are some operational measures of "quality" of education? What measures have been used? How satisfactory are they? What are the criteria of "satisfactoriness"? How widely accepted are they? Suggestions for improved measures?

4. How can we determine whether the "quality" of educational output has changed over time? What indexes of quality have been employed? What kind might be developed?

5. How can we measure the productivity o f enterprises producing "education? What is the productivity of the University of Wisconsin, of of one of its departments (e.g., Economics)?

6. It is frequently argued that education produces extensive "externalities"--- all of which are assumed to be positive. What kind of case can be made for the proposition that education produces certain negative externalities? Given the existence of positive and negative externalities, how might these compare with those produced by other types of public and/or private expenditures?

7. What is the price elasticity of demand for higher education (partial or total elasticity)? What is the "price" of higher education? Give some quantitative estimates. Has the changing composition of enrollments at public and private universities be affected by changing relative prices of education?

8. What is the value of the new GI Bill? What is the value if it is used by the individual? What is the probability that it will be used, as a function of age, region, family status, etc? What effects will its use have on the distribution of income?

9. Is the GI Bill a "good" thing? In what sense is it "good"? What is the significance of the fact that the GI Bill does not subsidize non-school goers? Is this a useful way to stimulate additional school-going? Does the fact that the GI Bill applies essentially only to males pose problems?

10. What is the "income elasticity" of demand for higher education? What is happening to the rate of college-going (and completion) among males vs. females in the U.S., in various regions? To what extent are these patterns explainable by income changes?

11. How applicable is "program budgeting" or "cost effectiveness" in evaluating educational programs? How might these techniques be applied to a university (such as Wisconsin), to a department (such as Economics), to a school system (such as that of Madison), or to one of the state or Federally-supported educational programs? What are the major problems encountered in applications such as these? What are the potential benefits?

12. What are the effects of such things as family income, social class, rural versus urban background, residence, ability, etc., on school-going? To what extent do income opportunities (expected income) and costs of education explain the differences associated with the above factors?

13. What explains the differential dropout behavior of various groups, among them minority, ethnic, social class, etc? To what extent do differences in expected incomes and costs of education explain these differences?

14. The correlation between level of education and unemployment. Why is there a correlation? Will it continue? How strong is the correlation? Do we observe this in other countries as well?

15. International flows of highly educated persons.--the "brain" drain. How large are these flows? In what directions arethey going? How can these flows be explained? What is their significance for economic growth, for resource allocation?

16. What are the rates of return on education for females? (use Census data, a la Becker, Hansen, etc.). How does the rate of return differ by region? How will it differ by extent of labor force participation; full-time versus part-time, by career versus non-career women? What are the special problems encountered in making such estimates for females as contrasted to males?

17. How do individuals finance their expenditures for higher education? What role is played by the private market for capital funds? public loan funds? grants, fellowships, and scholarships? How flexible and adaptable are each of those systems? What is their impact on the rate of return? What is their impact in altering the relative distribution of enrollments among various fields?

18. Is there any means by which we can estimate the rate of obsolesence of the outputs produced by education? What are the implications for on-the-job training, for retraining, for adult education? What is optimal strategy in choosing an occupation, given varying expectations about the possible rate of obsolesence?

19. Capital Markets for Education Loans

    How active is the private sector?
    What has been the effect of the public sector (e.g. NDEA, etc.)?
    What is the repayment record?
    How might the market be "improved"?
    How important are the underlying barriers?

20. Income redistributional Effects of the Higher Education System

    Who pays the taxes and who receives the schooling?
        Do low-income people have more or fewer children per family than higher-income people?
        Does rate of parochial-schooling and private school going differ by income level?
    How satisfactory are the Ribicoff Amendment and other tax-credit plans in this respect?

CHAPTER 20

101 Questions for Investigation

Willard L. Thorp[*]

SOME ASPECTS of higher education have been explored extensively, others have had only limited examination. Thus the academic library shelves contain many more printed pages about the philosophy of education than about the management of educational institutions. There is a much more nearly complete public record of railroad conductors' salaries than of college professors'. And we have many more sociological interpretations of trade union behavior than of faculty mores, unless fiction is included.

The social scientist has tended to concentrate his attention either upon the individual or upon the economic and political aspects of society, and to overlook education, although it could qualify under all three headings. The economist also has looked away because the pecuniary calculus is not readily available and there is great difficulty in defining and measuring the "product." Many of the economists' technical devices, such as marginal analysis, demand elasticity, product differentiation, cost behavior, comparative advantage, and input-output analysis, would seem to be relevant to various problems in the education field, but they seldom have been applied.

Similarly, the political scientist has concerned himself with only a few fringe problems in this field, perhaps because higher education has such a tradition of being a private operation even though State universities now carry the heavier load. Some few, like some sociologists, have studied the similarities of academic communities to other groups, and their differences, but the study has been more casual and episodic than systematic. The psychologist has been more deeply interested in the learning process than in the working conditions of the teacher.

This state of affairs is changing rapidly. Although the problems of education were important in the past, it seems clear that we are faced today with educational choices of increasing importance and difficulty, in terms both of public policy and of organizational structure and behavior. Greatly increased resources of capital, labor, and management are being demanded to carry education forward and to raise the standards of the weaker institutions. We cannot disregard the implications for education of the rate of population growth and the accelerating expansion of knowledge. The accumulations of data of various types, development of new research techniques and methods of analysis, and the recent availability of funds for research all suggest that much will be done to shed light on these problems during the present decade.

---

[*] This paper was first drafted after discussions held at the Merrill Center for Economics in Southampton, N.Y., in June 1958. Twenty-two economists and educators assembled for a week under the auspices of Amherst College and The Fund for the Advancement of Education to identify problem areas in the field of education where it was believed that research might be valuable. The author, director of the center, who presided at the sessions, made his own summary at the time, and has now amended and elaborated it somewhat further.

It seems clear that higher education is and must remain a process with wide differences among institutions. Although they may have quite different objectives, they do compete for students, faculty, and financial support. The wide spread in amounts of tuition in public and private institutions tends to create another source of conflict. And the national process of growth is pushing all of them to increase their productivity, whatever that means, within their limited resources.

These conflicts and pressures raise problems and some of them are listed below. It is obvious that it is an economist's list, although luckily the interdisciplinary boundaries among social scientists have rather low visibility. For the purposes of the list of questions given below, a number of broad and basic problem areas are not included, such as "What are the objectives of higher education?" or "How much higher education should there be and for whom?" or "What preparation is essential for teaching at various educational levels and in various types of institutions?" Problems concerning the nature and scope of the curriculum or the actual teaching process itself have been disregarded. Finally, the infinite possibilities of comparisons over time and space (especially international comparisons) have not been included in the list, although some of them might be very fruitful.

Many of the questions may be asked in terms of all education, of some type or level, or even of a single institution. It is important to note that research does not need to start with a broad coverage and an electronic machine. It is quite likely that some of the problems can only be stated properly after some individuals have made local and limited studies at their own college-level institutions, or in their own communities with respect to the public grammar- and high-school level. Analysis of costs, for example, needs to be developed in a number of individual institutions.

It is also important to realize that many of the questions asked should be considered with reference to various time intervals. A problem can be stated in its current phase, or in terms of a historical perspective, or in terms of forecasting the future. All these elements need to be considered, for the spot survey is likely to be difficult to evaluate unless one has some notion as to what the trends are.

The 101 questions do not present a complete or detailed set of problems in the field of higher education. They are intended to start the process of inquiry, and often a dozen or more questions are hidden in a single one. Although an attempt has been made to group questions that seem to be closely related, other schemes of arrangement would probably do just as well.

I. Extent and Structure of Higher Education

1. What is the direct contribution to national income which is [has been, can, should be] made by education? How should it be defined and measured?

2. To what extent does the demand for higher education reflect general business conditions and employment? How does the business cycle affect the resources available—the yields on endowment, legislative appropriations, scholarship needs, alumni gifts, and so forth.

3. What shares of various types of economic resources are devoted to educational activity in the United States? It might be useful to develop such data both in a product and in an industrial classification. Data as to capital employed are weak or nonexistent. In fact, capital goods like buildings are often not treated like capital; that is, with respect to depreciation, earned return, and so forth. Labor input needs to be examined in terms of degrees of skill and of divisions such as teaching, managerial, administrative, and maintenance.

4. How are resources (using national income subdivisions) distributed through the educational structure by level and type of education and by type and size of institution? At what points would additional resources be most productive?

5. Is there unused capacity in terms of plant and faculty? Where? Why? What appear to be present standards of use? Where does [should] obsolescence come into the picture? What motivation is there for change?

6. What is the relation between various inputs (and combinations thereof) and the level of student performance and accomplishment? Is it possible to develop meaningful concepts and techniques that would permit comparisons of performance among educational units, making appropriate allowance for differences in student potential?

7. What assumptions should be made as to future demands for higher education? What assumptions should be made concerning quality, quantity, and types of education?

8. What are the relative economic and other costs involved in

of an established institution, and expanding an established institution?

9. What are the relative economic and other costs involved in carrying on higher education in urban, suburban, and nonurban locations?

10. To what extent can the student "bulge" be met by expanding trade training and junior colleges? What effect would this have on resource requirements?

11. At what level should various subjects be taught? Can any appreciable saving be made by shifting the level and timing? Are extra costs incurred through not doing the right thing at the right time in the right place? What shifts and changes can be made in language study? What about remedial work and its proper location?

12. What adjustments may be needed at the college level if more "college work" is done in the high schools? How will this affect costs? Is there a similar adjustment problem between the college and the graduate or professional school?

13. What resources are now used in nonformal types of education; for example, music lessons and clubs for young people of school or college age?

14. What will be the future economic requirements for graduate and professional schools? How do their resource requirements and costs differ from those of college level institutions? How sensitive are graduate and professional schools to changes in demand?

15. How much specialized training is given and never used? What elements in past training have proved obsolete?

16. To what extent is there [will there be] further training added after the completion of formal education? What alternative methods are possible for providing specialized training and "refresher" courses? How would the costs of these methods differ?

17. What is the relation of research to teaching time and to availability of faculty to students? What is the basis for the financing of research and how much is contributed by the institution? To what extent is research a source of supplementary income to faculty and graduate students? What is involved in providing research facilities? How can [should] research interest be maintained in smaller institutions?

18. What peripheral activities affect income and cost and in what way—athletics, dramatics, university press, soil testing, employment agencies, and the like?

19. Who participates in the decision-making process in various educational institutions? In what ways do individuals or committees or other groups participate, both inside and outside the institution? Is there any relation between faculty participation in decision making and allocation of resources as well as in the obtaining of resources? What are the limitations on freedom of planning in publicly supported institutions? In private institutions?

20. What is the effect on colleges and universities of such market situations as location and competition? What are the competitive elements in the picture? To what extent and with regard to which matters are there trade agreements and interstate compacts? Do they contribute to more efficient resource use?

II. The Student Body

21. How can one define enrollment? What is the trend in enrollment by type and level of education?

22. What factors affect the demand for college entrance? How important are the tuition charges and other costs to the students? What is the likely trend of student costs? How is college entrance affected by changes in the level and distribution of family incomes? How many students are unable to enter because of faulty preparation?

23. What is the extent and character of the enrollment in private preparatory schools? What are the charges for tuition and other costs?

24. What is the basis for student choice among various types of institutions (public and private, rural and urban, large and small, etc.)? To what extent and at what levels of education do students first leave home for schooling?

25. Are there established geographical controls indicating that a locality requires an institution? To what extent do students go to State universities outside their own States, despite tuition differentials? Should there be a national travel allowance for students?

26. How much do differences in tuition charges among institutions affect the distribution of enrollments? (In connection with the more obvious facts, there might be an examination of multiple applications to see to what extent applicants apply to—and choose among—colleges of varying tuition levels.) Similarly, how much does the amount offered for scholarships appear to control choice?

27. How extensive are scholarship programs? On what should they be based? Ability? Need? High-school record? What should the scholarship cover? How does the development of national scholarship programs affect the operation of individual institutions' programs? Are sufficient fellowships available for graduate study?

28. How would substitution of low-cost, long-term loans for direct subsidization of tuition (low or no tuition charges) alter the college

entrance of students in various economic and social groups? What are the good and the bad elements in the various student loan plans in operation? What is the potential of a loan program and what is its likely cost, on a national scale, under various assumptions of coverage?

29. To what extent are educational institutions able to make intelligent selections among applicants? What are the existing methods of selection, their effectiveness, and their cost (in dollars and in tension among applicants)? What is [should be] the extent of formal education obtained by the high-school graduates of the highest brain power (perhaps the top 20 percent)?

30. Disregarding tuition and scholarship differentials, what other methods exist for competing for students? Advertising? Bonuses? Entertainment? Solicitation? Alumni persuasion or pressure? And how much are all standards distorted by special abilities such as forward passing or oboe playing?

31. Is there a tendency for prestige institutions, including graduate schools, to develop preferred sources for students? Are there observable geographical, racial, religious discriminations?

32. To what extent, when, and why do students drop out? How many return after an interval? What would be the saving if the attrition rate were higher or lower?

33. What is the possibility that junior-college graduates will enter 4-year college? How much does [can, should] this happen?

34. How extensive (and how desirable) are transfers?

35. What organizational requirements and costs are involved in the giving of advanced credit or of advanced standing or of acceleration?

36. What is the relationship of military service to the educational process? What can be learned from the GI bill experience? Any insight into college education and age, marital status, and experience?

37. What significance, if any, does the summer vacation have for students as to economic costs or earnings, and experience? Could it be utilized to greater advantage?

38. To what extent do college students work on the side? Would it be possible to substitute employment for scholarships to a greater extent?

39. Are there any observable consequences when the educational process is delayed or interrupted? What about intervals between college and graduate school?

40. What is the effect of early marriage on the students' financial needs and financial resources? On attrition of students in the colleges? On the education of husband and wife?

41. To what extent is there a trend for a semester or year abroad to be included for college credit? How is this inclusion organized? What costs are involved? What are the faculty requirements? What scholarships are required? Is such inclusion feasible on any considerable scale?

42. What are the apparent trends in the enrollment of foreign students in American educational institutions by level and type of institution? What special burdens are involved? How much special support is [should be] provided for this activity? Should it be more concentrated in a few institutions? Can these programs be evaluated?

43. What controls the enrollment in graduate and professional schools? Can one compare the number who go on with the number who might meet existing standards yet do not continue? How is selection made by students? How is their decision affected by tuition costs? Scholarships? Opportunities for employment? What is the attrition rate and why? Is there any apparent change in the quality of applicants and if so why? Do they tend to make multiple applications?

44. Is there any way of rating graduate and professional schools on an objective basis rather than relying on historical prestige? What information might improve student choice? Is there a danger of too much concentration of the better students in a few institutions?

III. Educational Costs

45. How adequate are present cost-accounting definitions and methods for educational institutions in terms of their relevance for managerial purposes, for comparative purposes, and for social evaluation?

46. What controls allocations of funds between departments and among various functions? How can costs be ascertained when teachers instruct at both undergraduate and graduate levels? Is there any basis for comparability? What variations in cost exist? Why are high-cost activities tolerated?

47. What has been the trend in the cost of education of various types and at various levels in recent years? What has been the trend in physical requirements, such as for classroom space, laboratories, library books? How has administrative cost behaved? Are there some resources which are more fully utilized than others?

48. What is the relation in marginal terms between cost and total number of students for various sizes and types of institutions? What is the relation in marginal terms between actual resource requirements and number of students?

49. What is the minimum cost of a 4-year college education and what are the added costs resulting from additions, decorations, and

diversions? What is the added cost of community living (dormitories and eating halls)?

50. What is the cost of operating a college for each of the academic years? How do junior-college costs compare with 4-year college costs?

51. What can be learned about the economics of class size?

52. What costs are involved in administering "independent study"? Reading courses? Honors work? Doctoral theses?

53. What are the material requirements for college operation? How can purchasing methods be improved? What about methods of buying and handling books?

54. What is the relationship between cost and multiunit operation?

55. Are there improved methods of space utilization and control?

56. What are [can be, will be] the effects on the cost of education and on faculty requirements of various innovations in instructional and administrative techniques and in utilization of new media of communication such as television?

57. What are the economic implications of a changed college calendar? Of an accelerated college course reducing the time to 3 years? The use of reading periods on or off campus? A year abroad as a part of the formal educational process?

58. What is the actual elapsed time for graduate work? What is the estimated cost of a Ph. D. and of the various professional degrees to the individual? To the institution? To society?

59. Can costs be reduced by additional cooperation between schools within a university and among universities?

IV. Teacher Supply and Salaries

60. What can be said as to the derived demand for teacher services, in terms of predictions as to enrollments?

61. What in fact does a faculty member do? What is his real teaching load? How much service does he give to the profession? How much time is devoted to personal scholastic maintenance and development? To what extent are nonteaching demands made on the faculty by the educational institution? What are the noncompensated demands made by the community? How equitably and by whom are these claims on the teachers' time distributed? To what extent are teachers required to perform tasks that might be performed by less expensive personnel?

62. What factors affect the supply of teachers—salaries and fringe benefits, degree requirements, social position, and so forth? How extensive is the move of high-school teachers into college teaching?

63. To what extent have faculties absorbed foreign scholars, and at what level of the college course have these foreign scholars been absorbed permanently or temporarily? In which fields? At what rank? Have any special costs been involved?

64. To what extent are graduate students engaged in teaching? In research? Are they teaching elementary or advanced courses? With how much supervision? At what scales of pay? How does this affect the overall budget? Does it delay the graduate work of the teaching fellow?

65. Where do graduate students finally go and why?

66. What has been the historical record of teacher salaries, with appropriate allowances for fringe benefits, conditions of work (including availability of outside employment), and the age and qualifications of the teacher?

67. How adequate are retirement arrangements for faculty and for other employees?

68. To what extent do teachers earn additional income through other employment? How do institutions safeguard effective instruction? How much variation is there in their procedures on outside employment and why?

69. How are faculty administrative positions handled, such as that of head of a department? Is extra compensation granted? Reduced teaching load? What should be the division of labor between faculty and administration?

70. What would be involved in more "refresher" or developmental activity for teachers? How costly, how necessary, and how valuable are sabbatical leaves?

71. What are the trends as to leaves of absence? How important are fellowships and grants for temporary absence from the campus as a factor in reducing the supply of teachers on duty?

72. To what extent is faculty housing provided? How are housing provisions administered? What is their economic role?

73. What salary differentials are [should be] found within institutions, and among institutions? By subject area? By character of preparation? By seniority? By type, character, and location of the institution? What would be the result of substantial increases in the top salaries?

74. To what extent do civil service requirements reach into public colleges and universities?

75. What costs would be involved in expanding the supply of teachers for junior colleges?

76. What is the nature of the labor market for teachers? Can it be improved? Is there enough, too much, or too little mobility and turnover?

77. To what degree does academic tenure prevent the management of an educational institution from behaving like a rational employer, removing "expensive" or incompetent employees?

78. To what extent do mature individuals otherwise employed shift to the academic world, and vice versa? What fields have the most mobility? Could not more women over 40 be attracted back to teaching or research?

V. Financing

79. What are the trends in the sources of financing of privately and of publicly supported institutions, including tuition as source?

80. Are any considerable number of private institutions under severe financial strain? What is the death rate of private institutions? Is the problem caused by competing low-tuition public institutions? Is there similar pressure on junior colleges? On graduate schools?

81. What is the economic effect of church sponsorship? On contributions? On faculty recruitment? Are special costs involved?

82. What is the actual burden on the taxpayers of public educational institutions? Of private institutions via tax exemption of gifts?

83. What is likely to be the future trend of private gifts? How is this related to income levels? To tax levels? What economic considerations enter into gifts from individuals, corporations, and philanthropic bodies to private institutions and to public institutions?

84. What is the record of alumni contributions? How do they vary by age of donor and by type of institution? Do they bear any relation to capacity to pay? To what extent do alumni contributions represent the equivalent of a delayed payment?

85. How are educational endowments administered? What economic principles should be applied?

86. To what extent are State and local governments in a position and willing to finance educational expansion at the junior-college or the 4-year college level? At the graduate and professional-school level? How would the situation be changed by various Federal programs of guaranty, credit, or grant?

87. How much income is the result of using facilities for noneducational purposes (campus for summer conferences, and so forth)?

88. What has been the experience—advantages and disadvantages—of Federal programs relating to education? What has been the

experience in land-grant colleges? In Government contracts? In the Reserve Officers' Training Corps? What bases might be used for allocating Federal aid to higher education? To what extent and on what basis should public funds be available to private colleges?

89. On the basis of estimated future enrollments, what plant construction will be required in the future? What costs are involved, broken down into public and private, geographical location, and type of facility?

90. With particular reference to capital requirements, what methods of financing, including tax sources, should be used for public schools and public colleges? What has been the financial experience with dormitory and other financing up to the present? When and for what purposes do [can, should] various types of institutions of higher learning engage in borrowing?

91. What forms of aid from foundations appear to have had the greatest impact upon educational institutions? Can directed aid in fact be prevented from spreading through the budget?

VI. Evaluation

92. Are there criteria and measurements of the historical development of education which might indicate its relation to American society? What seem to be the forces that controlled the development of education? Has education adapted itself speedily to changing needs? In turn, what was its impact?

93. Is it possible to break down the "product" into such elements as training for citizenship, general tools for living, and specialized tools, and then measure the allocation of resources to each purpose?

94. What part have institutions of higher education played as pools of skilled manpower and research resources in time of national emergency?

95. What resources do educational institutions devote to the advancement of knowledge? What is [ought to be] their future role in view of the expansion of industrial and governmental research and development programs?

96. What is the cost, or the benefit, involved in keeping young people off the labor market?

97. What part can education [educational institutions, educational resources] play in the development of less developed countries? How can this activity best be organized? What are the chief costs involved? How much priority should it be given as compared with other demands?

98. What is the level of educational investment by the State

tions)? Can specific benefits and results be attributed to publicly supported institutions? What is the relation, if any, between the level of education in the State and the level of productivity and of incomes? Of outmigration or inmigration?

99. What is the relationship between the degree of education and the level of personal income? (This not only involves the estimation of present worth of various levels and types of education, but also the development of a method of imputation to education when corrected for different initial endowments and economic and social advantages.)

100. What is the relationship between education and other measures of personal achievement? (Here also "value added" concepts must be developed along with methods of measurement.)

101. What is the present amount and productivity of resources now being spent in studying problems of education? And how can a greater number of competent scholars be induced to apply their skills and techniques to answering some of the above questions—and raising others?

Perhaps the last question should be the first.

Appendix C

Student Proposals:

Don J. DeVoretz
Peter A. Lundt
John Melder
M. J. Oatey
Marjorie Putz
J. A. Wilson

LINEAR PROGRAMMING AND EDUCATIONAL INVESTMENT

Don J. DeVoretz
Economics 968
April 3, 1966

Investment in education as any other productive expenditure requires a rationale for efficient allocation of expenditures to produce a maximum increment in output. Presently, two main techniques -- rate of return analysis and manpower planning have been used to maximize gains from educational expenditures. To proponents of either technique there are seen advantages as well as disadvantages to both approaches.

It will not be the purpose of this paper to extol or criticize either approach in great detail. Rather general remarks will be made to describe the theoretical underpinnings with the object of illustrating the need for a linear programming approach in a less developed country.

The rate of return approach essentially assesses the rate of interest necessary to equate costs with expected future earnings. The implicit assumptions of this method are many as Blaug has pointed out.[1] The important assumptions though in relation to application in a low income economy are the infinite elasticity of substitution among factor inputs, education as general education and positive student response to economic incentives.

In a less developed economy none of these assumptions are fulfilled. Factor inputs, especially teachers are not equipped to shift readily from one type of teaching to another. Also, the great demand for skills and early specialization often force formal training to end general education early in the student's career. Most important though is the lack of student response to economic incentives. A Philippine case study undertaken by this author showed a wide divergence between private action and social needs. The economic return for ~~these~~ certain skills was high but students refrained from training for these fields because of consumption reasons; i.e. prestige. This example is undoubtably repeated in many other low income economies.

This wide divergence from assumptions underlying the rate of return approach forces government action in lieu of inadequate market mechanisms to maximize social returns. This necessity for public action becomes even more evident when we add the uncompetitive and disequilibrium conditions of less developed labor markets to our list of broken assumptions. Subsidies and other forms

[1] M.Blaug, "Private Demand for Extra Education", Economica, Feb.

of government policy can be implemented to correct for these features and to maximize social returns.

However, it is one of the purposes of this paper to illustrate the complexity of implementing public policy given the criterion of the rate of return approach. If student response is lacking and government action is required how can government operationally determine the number of x skills and years of schooling required to equalize rates of return among educational levels and between education and other froms of investment? To say that x dollars spent on elementary education will equalize its return with respect to college expenditures is beyond calculation. Changes in marginal returns and marginal costs would have to be calculated for each student at each level of education in each time period and then marginal adjustments made. This is a Herculean task. For these reasons it would seem fruitful to search for an alternative method.

The manpower planning technique is designed to meet the operational requirements of a less developed economy. Given an overall growth plan with intersectoral growth targets skill requirements and educational investments can be determined. There is one basic operational weakness to this approach. If any of the industrial growth rates are inaccurately forecasted or the production function changes, the projected skill and educational requirements can be far off. Unfortunately, bad forecasts are almost certain in a low income economy where statistics are poor and unanticipated structural changes are many.

A linear programming technique offers a tentative solution to the operational problems involved in the rate of return and manpower planning approaches. Unlike the rate of return approach the linear programming technique does not require endless discrete estimations of marginal returns. Given the inputs and the cost constraint the proper mixture of all types of education, e.g. primary, secondary, vocational, etc. can be determined so that future earnings will be maximized. The linear programming technique could also determine the least cost method of educating certain skills if manpower projections were made. However, since projections are assumed unreliable this latter aspect of the linear programming technique will be ignored.

With this brief plea for the linear programming approach, a return to the projected outline of this study will resume. A case study of two low income countries will be made to suggest the feasibility of the linear programming technique. It is envisioned that life time earnings by level of education and occupations will be needed plus a detailed knowledge of the supply inputs. This will allow the formulation of the problem as such:

(1) objective function, i.e. what to maximize

$$Y = MAX\ [Z_1X_1 + Z_2X_2 + \cdots\ Z_NX_N]$$

Z = per unit value of a process

(2) technology matrix;

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_n
Primary Inputs	a_{11}	a_{12}							
	a_{21}								
Intermediate Inputs									
Final goods									

Xi = process

a_{ij} = input per unit level of activity

(3) constraints;

$$B = \begin{bmatrix} b_{11}X_1 + & \cdot & \cdot & \cdot & + b_{1N}X_N \\ b_{21}X_1 + & \cdot & \cdot & \cdot & \cdot & + b_{2N}X_N \\ \\ b_{K1}X_1 + & \cdot & \cdot & \cdot & \cdot & + b_{KN}X_N \end{bmatrix} \leqq C$$

$$X_i \geqq 0$$

Now the problem simply reduces to choosing the proper level of activity of each process variable (Xi) so that the objective function will reach an optimum within the constraints.

The obvious stumbling block in this method will be the availability of input data which formulates the technology matrix. For this reason Mexico and perhaps the Philippines will be used since the required data seem to be available. Also, in the latter case a comparison between the prescriptions of the rate of return analysis and the linear programming results will be attempted.

An overview of the entire proposed paper may be better seen through this outline:

I. Three Alternative Approaches to Investigate Educational Investment
  A. Rate of Return Technique; a description of the approach and its strengths and weaknesses will be reviewed
  B. Manpower Planning Technique; a similar description as in A.
  C. Linear Programming Technique: the basic rationale for preferring this method over the other two approaches.
II. Description of the Linear Programming Technique
  A. Formulation of Various Objective Functions

B. Developing the Technology Matrix
C. Definition of the Constraints

III. Application to Mexico and the Philippines
   A. Presentation of Objective Functions, Constraints, and Matrix.
   B. Description of Results in Terms of Expenditures on Various Levels of Education.
   C. Comparison of Rate of Return Results and Linear Programming Conclusions.

IV. Summary, Suggestions, etc.
   A. Summary of the Results in Both Case Countries
   B. Possible Avenues of Further Research

NB. At the present time I am engaged in reading Spivey's Linear Programming and Dorfman Samuelson and Solow's Linear Programming and Economic Analysis for background. I am also investigating sources of data for Mexico and the Philippines, which include:

(1) Randall, Laura, The Process of Economic Development in Mexico.
(2) Sanchez, G. Mexico, A Revolution by Education.
(3) Booth, G.C. Mexico's School Made Society.
(4) Johnson, W.C. Education in Mexico.
(5) Kneller, G.F. The Education of the Mexican Nation.
(6) Central Bank of the Philippines, Statistical Bulletin XVI ~~&~~ XVII.
(7) Goodstein, M. Pace and Pattern of Philippine Economic Growth.
(8) Bureau of Census, The Philippine Statistical Survey.

THE FACTOR PROPORTIONS OF CANADIAN TRADE: A PRELIMINARY RESEARCH PROPOSAL

Peter A. Lundt

May, 1966

Economics 968

Wassily Leontief's celebrated articles "Domestic Production and Foreign Trade: The American Capital Position Re-Examined"[1] and "Factor Proportions and the Structure of American Trade: Further Theoritical and Empirical Analysis"[2] created what has come to be known as the 'Leontief Paradox'. The theory of international trade has been in a rather unsettled state ever since.

On the surface, the 'Leontief Paradox' appears relatively simple. The Hechscher-Ohlin Theory suggests that a country would tend to export those goods which were intensive in those factors of production in which the country was relatively well endowed; and that it would tend to import those goods which were intensive in those factors of production in which the country was relatively less well endowed. International specialization is based on relative factor proportions.

The United States, which is accepted to be capital intensive vis-a-vis the rest of the world, should export capital intensive goods according to this theory. Leontief's empirical study contradicts this theory. His study seems to indicate that the United States exports labor intensive goods and imports capital intensive goods.

Leontief bases his findings on an analysis of the structure of the American economy which was conducted by the Harvard Economic Research Project. The data base is the 200 x 200 input-output table of 1947. This table describes the flow of goods and services throughout the economy. A column of an input-output table describes the input from all the industries in the economy required per unit of output of a given industry.

Within the flows for a given base year, Leontief assumes a constant-coefficient production function and calculates input coefficients for all industries. If, for example, one million dollars worth of output of industry X used $100,000 worth of industry Y's output as input in the base year, two million dollars worth of industry X's output would require $200,000 of industry Y's output as input. Given the coefficients, one can calculate the requirements throughout the economy for any given change in output.

Using this table, Leontief computed the direct and indirect capital and labor requirements per million dollars worth of output for those industries whose products are traded on the international market. The direct requirements, i.e. the capital and labor requirements, for a million dollars worth of output in an industry, were computed from the 200 x 200 table. The indirect requirements, i.e. the requirements of the output of other industries which the industry in question uses as input, were computed from a consolidated 50 x 50 table.

Using these capital and labor requirements, Leontief examined the relative capital and labor proportions of one million dollars worth of American exports and import-competing output. Since Leontief did not have data on the factor proportions of that foreign output which composes the actual United States imports, he was obliged to compare the capital and labor requirements of one million dollars worth of American exports with the capital and labor requirements of one million dollars worth of American produced import-competing output. Import-competing industries are defined as those industries which have a substantial output in the United States, but compete with like commodities imported into the United States.

Non-competing imports, those imports for which there is no competitive American production, such as coffee, tea and jute, are excluded. Leontief imagines a situation where the United States reduced its exports and imports by one million dollars. The capital and labor requirements to increase import-competing productions, i.e., replacing, are compared with the capital and labor released in the export sector. Non-competing imports are held constant; only competing imports are assumed to change.

Leontief's empirical analysis indicates that relatively more labor and less capital are required to produce one million dollars worth of United States exports than to produce one million dollars worth of import-competing production in 1947.

This would suggest that the United States specializes in labor intensive goods. The only explanation which Leontief gives for this is that one man-year of American labor combined with a given quantity of capital must be three times more efficient than foreign labor. He adds that the higher productivity of American labor cannot be due to the larger amount of capital per worker in the United States. If substitution of capital for labor were profitable in the United States, it would also be profitable in corresponding industries abroad. The possibility of technological substitution is available to the whole world.

The controversy surrounding the 'Leontief Paradox' raises several interesting questions. Not the least of which is the need to explore the actual factor proportions of exports and imports in more detail than that of simple capital-labor ratios. Any revision in the present theory of international trade will, of necessity, have to be based on quantitative data.

A quantitative evaluation of the quality of labor would be a definite means of improving the available data. For it seems clear that all labor is not equal on the basis of physical input, even the different amounts of capital combined with it are accounted for.

In addition, there would seem to be an indication that labor in the export industries is of a higher skill level than labor in import-competing industries. Kravis' study,[3] for example, has shown that wage rates in export industries are systematically higher than in import-competing industries. My own research has also indicated that export sector labor is significantly better educated, i.e., contains more human capital, than import-competing industries' labor.

Insofar as research is in progress on the factor proportions of United States foreign trade, I should like to explore the factor proportions of Canadian foreign trade with especial reference to educational requirements. For it is desirable to study the factor proportions of foreign trade of more than one country in order to estimate the effect of peculiar national characteristics and/or conditions on the factor proportions of foreign trade.

The direct and indirect capital and labor requirements of Canadian foreign trade have been calculated by Donald Wahl,[4] using the Canadian input-output matrix for 1949, and the capital requirements estimated by W.C. Hood and Anthony Scott.

Using the Canadian Census for 1951, I can estimate educational levels, occupational distribution, skill levels, and distributions by sex and age for Canadian industry on a sector by sector basis. These sector by sector estimates can be converted to the 22 sectors used in the input-output matrix developed by Wahl.

Using Theodore Schultz's estimates of resource costs of education in the United States[5] as proxies for Canadian costs, I can estimate human capital requirements for Canadian foreign trade. These could be grafted onto the existing capital-labor requirements for Canadian trade to produce a Leontief type estimate of capital, both human and physical, and labor requirements of Canadian trade.

The analysis can be developed further, however. The industry by industry requirements of education, skills, occupations, etc. can be regressed on the industry by industry share of Canadian trade to yield quantitative estimates of the importance of these factors in Canadian trade. An industry's share of foreign trade can be expressed as its share of aggregate Canadian trade, of world market, of its change in share of world market, and/or its share in Canadian trade towards certain regions such as the United States, Western Europe and the lesser developed countries.

Several problems which are likely to develope in the course of this study can be anticipated in advance. The labor requirements of Canadian trade estimated by Wahl were established on the basis of wages and salaries paid, rather than on a physical input basis. Since it could be expected that wage rates and education are correlated, an upward bias in the effects of education could be introduced. This could be controlled for by re-evaluating the labor coefficients in terms of man-year inputs. The wage structure in each industry can be derived from Canadian Census data, and can be used to convert the labor coefficients to a man-year basis.

A further problem would be that of natural resources. Many suspect that an endowment of natural resources strongly influences the structure of a country's foreign trade. This could swamp the effects of differing educational levels in the various industries. This could be corrected by using an export requirement for natural resources derived from sectors defined as natural resource intensive. Jaroslav Vanek has estimated natural resource requirements for the United States by this method.[6] These requirements could be used as a proxy in the Canadian case.

It should be noted that this study could be extended to include not only more data, but newer data. More variables, such as research and developement expenditures, degree of concentration, well defined natural resource requirements and newness of capital, could be considered. In addition, The Dominion Bureau of Statistics is schedualed to publish an input-output table for 1961 in the near future. This could be combined with the Canadian Census data for 1961 to update the study. The two sets of results could be compared to give a very limited intertemporal view.

FOOTNOTES

1. Leontief, Wassily, "Domestic Production and Foreign Trade: the American Capital Position Re-Examined", Proceedings Of The American Philosophical Society, 97:4:1953, pp.332-349.

2. ...."Factor Proportions and the Structure of American Trade: Further Theoretical and Empirical Analysis", Review Of Economics And Statistics, 38:1956, pp.386-408.

3. Kravis, Irving B., "Wages and Foreign Trade", Review Of Economics And Statistics, 38:1956, pp.14-30.

4. Wahl, Donald F., "Capital and Labor Requirements for Canada's Foreign Trade", The Canadian Journal Of Economics And Political Science, 27:1961.

5. Schults, Theodore W., The Economic Value Of Education, New York, 1964.

6. Vanek, Jaroslav, The Natural Resource Content Of United States Foreign Trade 1870-1955, Cambridge, 1963.

John Melder
Econ 968
18 April 1966

EDUCATION AND INCOME REDISTRIBUTION

It often has been posited that education acts to redistribute income. The purpose of this proposed study is to investigate the veracity of this statement. Does education, in fact, tend to equalize the distribution of income, and, if so, to what extent? These are the primary questions to be considered.

One immediately is faced with the necessity of making limiting assumptions. Education is a lifelong process. But for the purpose of this study, I shall limit it to that produced in the 12-year public school span. The question, then, becomes: What effect does the public school educational system have on income distribution?

It is taken as given that education does increase an individual's lifetime earning potential. At issue is whether the educational benefits are distributed in a manner which maintains the existing income distributional curve, or whether public school education is a means of smoothing the curve.

(At this point, I still am uncertain as to the income group classifications I will use, but most probably I will consider a family with two children earning under $3,000 as poor, and a similar sized family earning more than $3,000 as non-poor. For each child over two, I will add $600. Thus a family with four children and an income of $4,000 would be considered poor. In the interest of brevity, I will assume that needed data is available.)

The analysis will study the distributional question from both the cost and benefit side. First, I will determine the proportion to which the two groups share in the benefits of the schools. And here I shall assume that all the benefits are embodied in a high school diploma.

I shall assume that those who are graduated from high school will be distributed by income level in the same proportion as those with similar characteristics (age, sex, race) are now. The same shall be assumed for those who do not graduate from high school. For these computations, I will use U.S. census data.

While these assumptions are a bit unsatisfactory, I believe they will give a useful first approximation of the income redistributional effects of the public school system. The pivotal point in this analysis will be the percentage of possible high school graduates who do graduate compared with the percentage of poor in the school district's population. Thus if 30 per cent of the district is poor but only 10 per cent of all possible graduates fail to get a diploma, this may reflect a shift in income towards the poor.

Secondly, I shall investigate how the two income groups share in the financial support of the schools. Does their percentage share of support follow their percentage share of the population? However, for the purposes of this paper the cost side will not be fully exploited since I am hoping to develop this more fully in a later and more comprehensive examination of the income redistribution question.

Thus the analysis will proceed in a two-pronged fashion. On the one hand, it will examine the cost side: who pays for public school education, and what are the distributional implications. On the other hand, I will attempt to determine how the two income groups share the benefits.

It may seem, for example, that one indication of redistribution would be the finding that the non-poor contribute more than their share to the support of the school district's educational program. However, this is only one part of the answer and, perhaps, an incorrect one. Why? Because it also is possible that the non-poor may take more than a proportionate share of the benefits.

For example, assume that the non-poor constitute 70 per cent of the school district's population, but contribute 90 per cent to its financial support. But assume also that children from the non-poor group constitute 95 per cent of the beneficiaries of the education. In this case, one might conclude the system, in fact, serves to make the distributional curve more skewed.

Therefore, I will look at the composition of high school graduating classes along income classification lines to determine how this distribution compares with the population distribution in the school district.

Implicit in this analysis is the assumption that all graduates benefit equally from the high school diploma. I am ignoring post-high school education plans (at least in this paper). As mentioned above, I will treat all graduates as just that--high school graduates. I then will determine--based on age, race, and sex variables--the proportion of these graduates that will fall into the "new" poor and non-poor groups.

METHODOLOGY

I plan to use a case study approach, using a school district in the Madison area, and, at this point, the Sun Prairie district appears to be the most likely candidate. I will attempt to determine which income groups "pay the bill" in the district in real and proportionate terms. I also will attempt to determine who are the beneficiaries (e.g., high school graduates over a five to 10 year period) and into what income groups their families fit.

I also plan to break down the per capita student expenditures into federal, state, and local tax components and use this to determine how the poor and non-poor's share is divided among the three taxes. This will illustrate which tax form has the heaviest redistributional implications.

Once I have the per capita breakdown by poor and non-poor groups, I think it would be interesting to see how this pattern would shift if each student's family paid the total per capita cost of his education. This comparison would reveal how the income groups presently share the cost of education and how they would share the cost if each student paid his full average cost.

Another area of major concern will be the dropout percentage of each graduating class. I will take as the maximum number of possible graduates the number present in the graduating classes' freshman year, less deaths and transfers and plus immigration. If for example, the 1965 graduating class had 100 members in 1961--the freshman year--and two students died and 15 moved out of the distritt, but seven immigrated, then the maximun number of graduates would be 90. If 81 graduated, the dropout rate would be 10 per cent.

I will compare this rate with the percentage of poor in the district. If it, too, were 10 per cent, then one might conclude that the income distributional pattern would not change much.

In this model, then, one of the measures of redistribution will be the comparison of the dropout percentage with the percentage of poor in the district's population.

The reason appears obvious. Current data shows us that the bulk of the non-poor are non-graduates. Intuitively, one feels that the large percentage of the non-graduates will join the new poor group. Add to this group the percentage of high school graduates--based on age, race, and sex variables--who also will join the new poor and one could conclude reasonably that the new poor group probably will come close to equalling the present ~~px~~ breakdown in the school district.

(Implicit in this approach is the fact that the viewpoint is regional rather than national. In other words, all variables affecting labor demand--exdept the changes in the number of high school graduates --will be held constant.)

SUMMARY

The study, then, will seek to answer the following questions.

1. To what extent to the two income groups (poor and non-poor) share the benefits of the system?

2. To what proportion do the two income groups support the district's educational system?

3. What do these findings reveal about the income redistributional effects of the public school system?

4. How can this limited model be expanded into a general model?

5. What are the policy implications of the study?

M. J. OATEY
Economics 968
4April 1966

Institutional and On-the-Job Training.

My topic will be a comparison between formal training in an intitution and informal training on the job, based on economic and/or psychological considerations. The workers concerned will range from non-professional technicians down to the hard-core unemployed. An application of such a comparison would be concerned with the Manpower Developement and Training Act, 1962, which provides for both forms of training; and there are implications for long term continuous retraining policies.

De

Definitions

On close inspection, the meaning of the two terms is rather vague, and it is not clear how different people are using the two terms.
One distinction is to simply make on-the-job training equivalent to an " in-company " activity, while intitutional training is an " out-of-company " activity.
However, it may be more fruitful to regard the two as forming a continuum. The institutional extreme would be full-time formal cousses at a technical or vocational school, and the on-the-job extreme would cover a worker being informally shown his job on the shop ~~feilr~~ floor by another worker or a foreman. Between these extrumes lies: anything from 1 hour a week to 4 hours a day formal or semi-formal instruction in a factory" classroom " ; short full-time courses in an in-company institution, etc., 1/2 to 3 days a week in an incompany or out-of-company institution.

Economic considerations

There seems to be a general feeling the "on-the-job "training is cheaper than "institutional " training (1,2), but I have seen no quantitative comparisons. How much cheaper is on-the-job training ? Is it always cheaper ? How will variables such as the nature and complexity of the subject matter, and the intelligence and experience of the trainees affect relative costs ?

Psychological considerations

Again the nature of the subject matter and the trainees will affect the psychological considerations.
For example, low intelligence trainees that have probably experienced failure and humiliation at grade school or high school, will tend to transfer anxiety to all forms of formal instruction* - hence informal on-the-job training may be more deffective in this case.
An example, contrast the amount of learning , as opposed to pratice , required. A skill involving much practice of easily learned principles should be suited to an approach nearer the " on-the-job "end of the continuum, and v.v.

---

*a negative externality of education

Organisational considerations

These would include the feasibility of providing instruction on the shop-floor; the avaibility of foremen or instructors; the location of factory classrooms; nature of teachings methods, etc. An example of the last factor is the advent of self-instructional systems suitable for use for 1 or 2 hours at a time - which would fit well into on-the-job training programs.

PROPOSALS

I have not yet arrived at a definite proposal since I have not surveyed all the relevent literature to determine the nature of data available. There are many specific hypotheses that can be generated by the approach above (such as the one suggested by the Bureau of the Budget: the rate of return to institutional and on-the-job training by previous schooling of the trainees). Which, if any, hypothesis could be tested will depend on the relevence of the data already available, or the feasibility of an empirical study.

There is some published data on training costs (3,4,5,6,9,10), but it is rather general and is not broken down ~~xxxx~~ very much. Also, it tends to be relevent to more institutional training than on-the-job activities. Costing of on-the-job training is very difficult (11).

An empirical study involving a direct comparison of the two forms of training has the major difficulty of finding two training programs in opposite halves of the continuum with directly comparable objectives.

A uestionnaire survey could be made to investigate trainees' attitudes and experiences of the two forms of training; or to determine employers'

..........[illegible]..........................

and public administrators' experience of the costs and effectiveness of the two approaches.

Finally, another proposal could be to develop the general analysis begun in this paper, as opposed to the regorous testing of a specific hypothesis (ie. the development of economic, spychological and organisational criteria for deciding on the form of training for any given situation). Existing data could be drawn upon together with some new empirical work; and the criteria developed applied to case studies.

(1) Becker J.M. In Aid of the Unemployed. 1965 (p.246)
(2) National Manpower Council. Improving the Work Skills of the Nation. 1955 (p. 142)
(3) Page D.A. Retraining Under the Manpower Act: A Cost Behefit Analysis. 1965
(4) Somers G. A Cost Benefit Analysis of Manpower Retraining. 1964
(5) Bonis M. Cost of Retraining Hard Core Unemployed. Labor Law Journal . Sept 1965
(6) Education and Training. Dept. of Labor 1965
(7) Factors in Workers Decisions under Manpower Act. Dept. of Labor 1964
(8) Motivatonal Contraints to Retraining. Cornell Univ 1965
(9) Serbein O.N. Educational Activities of Business. 1961 (p.9)
(10) Annual Reports of the Secretary of Labor on the Manpower Act 1863,64,65.
(11) ON-the-job Training. Mincer J. JPE Supp. Oct 1962

STUDY PROPOSAL
ECON 968 WORKSHOP
May 3, 1966
Marjorie Putz

UNIVERSITY EXTENSION CONFERENCE AND INSTITUTE PARTICIPANT IMPACT

Even though a study on the impact of student immigration on the State of Wisconsin seems to have great possibilities for several reasons - apparent need for such a study, willingness of State and University personnel to co-operate, and the existence of some exemplary work - it has been decided to concentrate entirely on a study involving the University Extension Division conference and institute participants. Time element, availability of raw data, and proximity of the conference site, the Wisconsin Center building, in addition to a stated need for this specific study are facts responsible for the change from student to adult student impact study.

> There is a long and honourable tradition from Adam Smith to Alfred Marshall which assigns to publicly supported education a major role not only in promoting social peace and harmony, and self-improvement, but in the process of wealth-creation itself.
>
> John Vaizey
> The Economics of Education, p.23

Continuing education programs (synonymous for present purpose with adult education) as sponsored by The University of Wisconsin Extension Division and conducted at the Wisconsin Center building assume in every respect the traditional role assignments mentioned by Vaizey. People from many walks of life and levels of attainment attend the Center education programs to be a part of the development of methods and the institution of measures for self- and societal-improvement. Obviously, because of the influx of these thousands of participants a certain impact is realized by the Madison area in relation to the services and dollar investments required to organize and present the programs and to cater to participant needs.

I propose through this study to identify possible advantages and disadvantages and to attempt to determine the nature and degree of benefits, positive and negative, realized by Madison and its environs from the presence of University Extension conference and institute participants in the area.

The Wisconsin Extension Division is one of the country's leading institutions of continuing education and one which similar institutions look to for ideas and standards. The general principle basic to the establishment of Extension service is the need to communicate clearly and continuously the resources and requirements of the university to its patron community. To this end the Wisconsin Extension Division operates in three major directions: correspondence study, credit classes, and informal instructional services. The Division has 30 academic departments and related professional bureaus, six educational service bureaus, seven administrative service departments, ten field offices and a staff of 400. The instructional work of Extension has reached annually 12,000 correspondence study students, 15,000 class students, 30,000 institute registrants, and unnumbered individuals and groups in almost 1,000 Wisconsin communities.* Of concern to this study is the farreaching nature of the Extension operation and specifically the numbers involved in institute registration.

The Center building with exhibit display areas, specially equipped discussion room, a 200-capacity auditorium, lounges, office space, about 20 varying sized meeting rooms, closed circuit television, speech recorders, and food catering services, is the Madison campus designated meeting place for adult education groups. As later figures will prove, the building and its facilities are in constant and extensive use.

---

* Cooperative Extension description and figures are not included

The proposed study will consist of three separate but related phases:

I. Interpretation of records of 1964-1965, October through September, conference and institute registrants

II. Administration of questionnaire to Center participants during one week in the early 1966 season, possibly May 16 though May 21

III. Contacting selected sampling list of 1964-1965 registrants by mail or in person if there are attending 1966 sessions, for follow-up information regarding subsequent use of the Madison area.

The 1964-65 Center records list about 40,000 conference and institute participants. This will prove to be the phase providing the largest population and probably the least information. The name and type of conference attended, its duration, the name, business location, business title, and home state of the participant, and services extended by the Center and Extension are roughly the kinds of data available. However, from this source can be determined the number of participants traveling to and from Madison from out-of-state and out-of-area. Using an average spending figure for participants procurred through phase II of the study, and taking into consideration any significant changes in service and food costs within the last year, generalized deduction should produce the amount of spending done in the area by 1964-65 conference participants.

Phase II, which is really phase I since we hope to use the questionnaire almost immediately, is designed to yield as much information as the traffic will bear. Questions are on a single sheet, worded to require only checks or figures, and will be distributed and collected during the same session to insure as high a return as possible. Coordinators of the conferences will be solicited in advance for cooperation. It is expected that the aggregate of this information received from about 1000 participants will result in a traceable pattern of use of services and facilities in the Madison area and the amount of dollars spent. The list of groups to be contacted are as follows:

		(Length of conference)
Language and Literature Lecture	150 people	one day
Collective Bargaining Institute	40	four days
Department of Nursing - In-service Educational Program	40	four days
Extension Leadership Methods Management Institute	30	three days
Department of Nursing-Psychiatric	25	two days
Finance and Accounting Management Institute	15	three days
Marketing-Non Marketing Executives Management Institute	15	three days
U.W.League	125	one day
CPA Examination	30	three days
Joint Committee on Education	25	one day
Administrators of Special Education	100	one day
Social Work Conference	150	two days
Economics Symposium	120	one day
Wisconsin Heart Association	200	one day

Phase III is not clearly developed yet. In fact the one definite reason for contacting 1964-65 participants is to attempt to determine whether latent benefits are being realized as a result of the initial conference trip to Madison. Specific approaches have not been planned.

Questionnaire - Phase II

In order to attempt a measurement of Madison area benefits derived from Wisconsin Center activities, may we ask your cooperation in answering all of the following questions.

1. Legal residence Outside Wisconsin_____ In Wisconsin_____

Within 150 miles of Madison________

__________ county __________ city __________ state

2. Occupation____________________________

3. Level of education (circle year completed) Elementary 6 7 8
High School 9 10 11 12 College 1 2 3 4 5 6 more

4. Method of travel to and from Madison Driving car__ Passenger in car__
Plane__ Bus__ Train __ Other__________________

5. Arrival date______ Time of day_____ Departure date____ Time_____

6. Approximate total mileage round trip__________________

7. Number of out-of-town guests visiting Madison with you____________

8. For each expense item listed below, please enter estimated figures covering the duration of your stay for this program.

Lodging	Hotel or motel	__________ number of nights	$__________ total spent
	Private home	__________	__________
	Own home	__________	
	Other	__________	__________
Meals	At Wisconsin Center or Union (part of program)	__________ number	$__________ total spent
	At Wisconsin Center or Union (not part of program)	__________	__________
	At restaurant, hotel, etc.	__________	__________ incl. tips but not bar bills
Travel	To and from Madison		
	Ticket bought in Madison	ye____	__________
	In Madison		__________
Entertainment			
	Theater, concerts, movies		__________
	Sports		__________
	Refreshments (incl. bar bills)		__________
	Shopping		__________

This study is being conducted in cooperation with Mr. Kenneth Rindt of the Commerce Department, Extension Division. Wider comprehension and added facility are therefore brought to bear on the project. We will work areas of mutual concern in concord and areas of individual interest independently.

J.A. Wilson
Econ 968

TIME/COST TRADE-OFFS AND EDUCATIONAL FLEXIBILITY

1. Pufpose: There is a cost and a benefit to flexibility in the educational process. As certainty with respect to future manpower requirements rises, the specificity of training may be increased and the cost lowered, and vice versa. The problem posed in this proposal is twofold: (a) In order to solve the flexibility problem a pattern of time/cost trade-offs must be established for selected occupations. Or to put it in a somewhat different manner, the existing means of production must be surveyed and described in economic terms for each occupation. (b) The role and importance of uncertainty must be established.

2. A dual view of flexibility: Flexibility enters the occupational 'production' process in the form of allowing a decision with respect to specialization to be put off to a future date in the face of uncertainty. Its primary benefit is that the passage of time, which it allows, has the effect of reducing uncertainty and raising the probability of a correct decision with respect to specialization. A second aspect of flexibility occurs after the period of specialized training; in this instance the flexibility, acquired through general training prior to the period of specialization, remains (somewhat depreciated, of course) and can be taken advantage of (in the event that the original specialization decision did not turn out too well) through increased re-training options, and probably also continued training.

3. Problems of measurement--theoretical aspects.

(a). Time/cost trade-off curves vary as educational method changes. But since these curves are relevant over a sufficiently short period of time (the period of decision making relative to the life of the investment), it is doubtful whether changing educational method will have any effect.

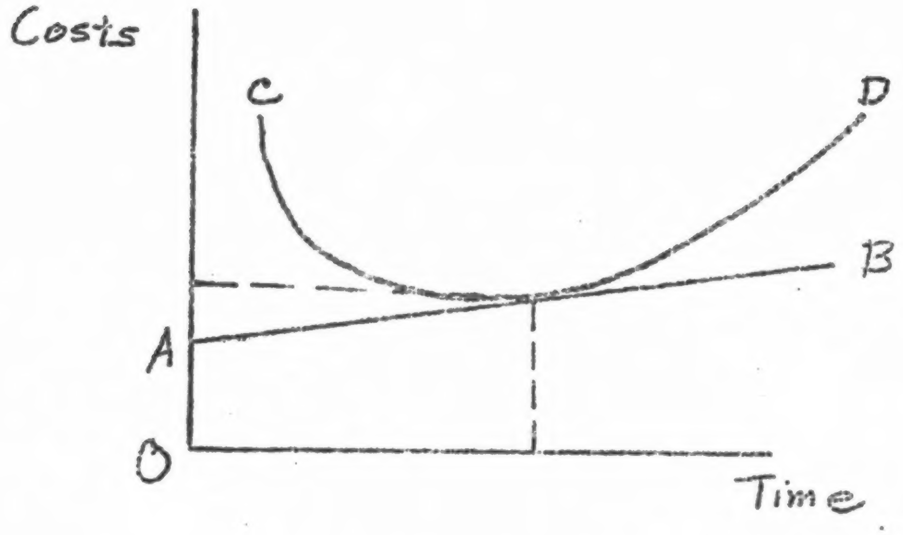
(b) Establishing the trade-off curves will be another question. This will involve an investigation of known techniques of training and estimation of their costs and time--no mean task!

(c) Graph I shows the usual time/cost trade-off curve; however, because of the nature of the educational process the passage of time entails the cost of generalized education. Graph II shows this. The effect of these additional costs is to make the trade-off curve bend much more sharply than it would have had the costs not been there. This is important as will be brought out later.

(d) If EF in graph II represents a line of points derived from the possible means of training for an occupation (CD) plus the accu-

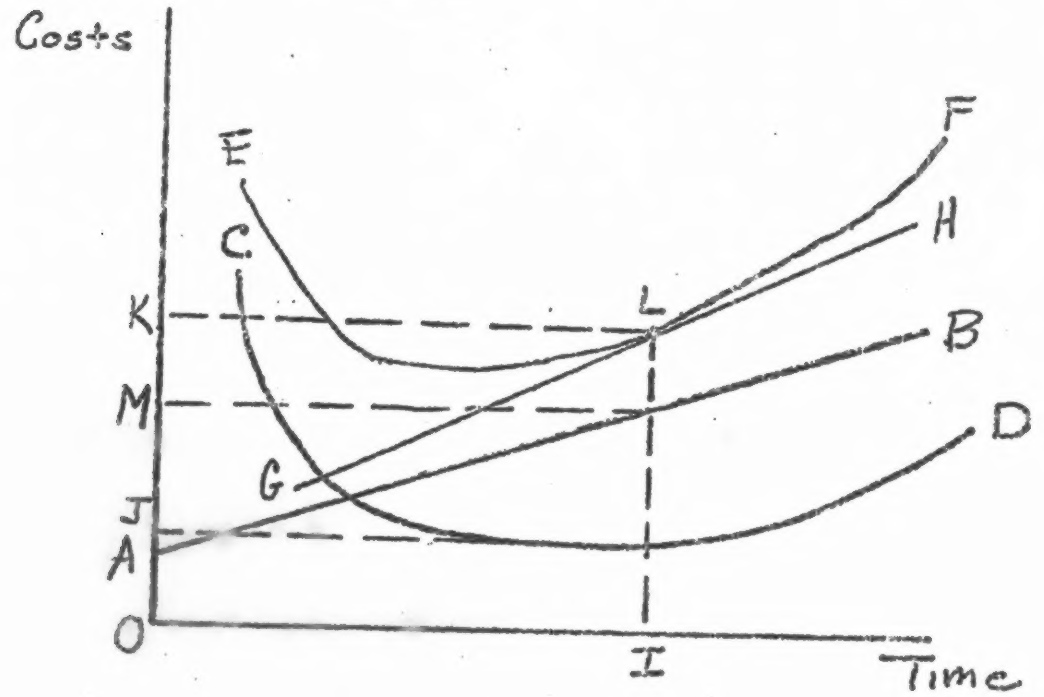
Cont. page 3

GRAPH I



Where AB is determined by the uncertainty inherent in manpower forecasts and CD is the time/cost trade-off curve.

GRAPH II



AB = accumulated cost of general training over time
CD = time/cost trade-off curve for specialized training
EF = final trade-off curve, i.e. AB + CD
GH = uncertainty function

Note: The CD curve represent the total cost of specialized training if begun after any particular year of general training as indicated on the horizontal axis. Thus, say the uncertainty function was tangent to EF at point L; this would indicate that specific training was to begin after OI years of general education and that the total cost of specific training will be OJ; of general training, OM; and the total cost of education will be OK (no pun intended).

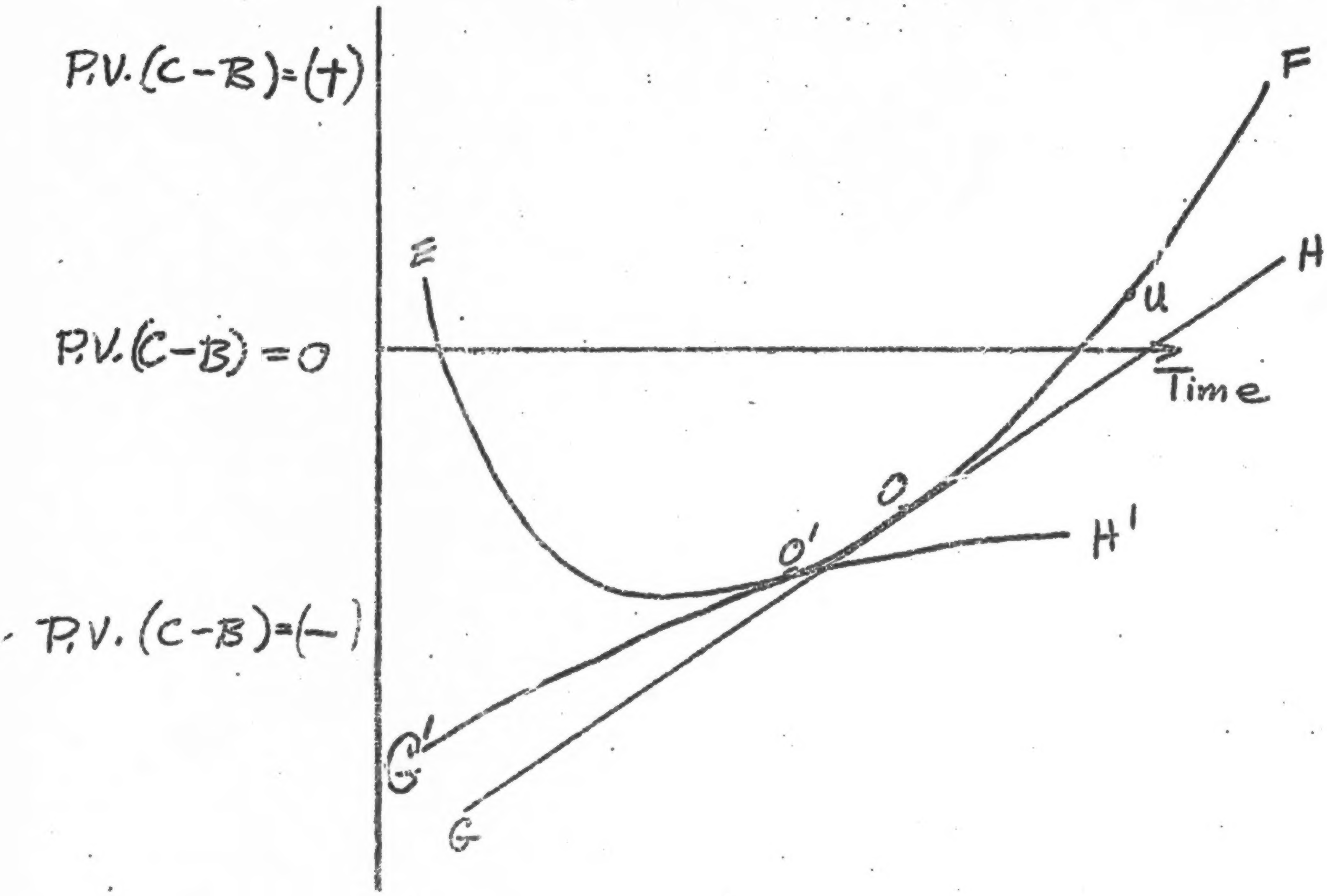
mulated cost of general training up to each point in time, then the optimum point will be found where the slope of the curve is equal to the degree of uncertainty (expressed as a slope, 1>U>0). The graph seems to make sense since as the degree of uncertainty rises the optimum point on the trade-off curve recedes in time. An interesting thing to note with respect to the shape of EF is that the more sharply the line bends the less the degree of uncertainty will affect the decision as to when to begin specific training. EF will be bent more sharply as educational methods are more inflexible with respect to time/cost trade-offs.

(e) It is possible to draw a graph similar to II but giving a little more information simply by putting the present value of cost minus that of benefits on the veritcal axis. The graph would make use of the first and fourth quadrants, every point in the first quadrant being a point where costs exceeded benefits. See graph III. One advantage to using this type of graph is that it also presents a crude investment criteria; i.e. where PV(C-B) = 0. For example, say the trade-off curve were the same as in graph III but that there was a great deal more uncertainty than represented by GH. Assume this new uncertainty function had a tangency with EF at the point U. Obviously at this point the degree of uncertainty has become so high that the expected present value of the investment will be less than zero.

(f) As yet I have not dealt with the effect of the second aspect of flexibility--that is the continuing flexibility afforded by general education. Now since this aspect has the effect of increasing the options (of occupations) open to a person it has the effect of lowering future uncertainty. Or in other words, it has the effect of raising the probability of employment and the future returns to the educational investment. Thus the effect ~~ef~~ on the function GH in graph III is to lower the slope at every point as general education increases. This will cause the new function, say G'H', to have a tangency with EF at a point O' to the left and below the previous optimum O. Thus, the retentive qualities of general education permit specific training to begin at an earlier period and, not surprisingly, lower the total cost of education.

4. The proposal of the paper, then, is to attempt to go through the above analysis for one or a few selected occupations.

GRAPH III



The vertical axis is denoted as costs minus benefits because I didn't want to invert the graph as would have been required if I were to write benefits minus costs.

Appendix D

Selected Papers of Outside Speakers:

T. W. Schultz, University of Chicago

E. F. Denison, Brookings Institution

Daniel C. Rogers, Yale University

Investment in Human Capital Series
Paper 66:01; February 22, 1966
The University of Chicago

Response of Schools and Students to Economic Growth

Theodore W. Schultz
The University of Chicago

Although there is no longer room for doubt that acquired skills and knowledge yield valuable productive services analogous to other forms of capital, it is not clear what causes the process of economic growth to alter the economic value of the different skills of the labor force and what factors determine the response of schools and students to changes in the demand for the different skills and to what extent these responses give rise to malinvestment in schooling.

I shall contend, taking an investment point of view, that modern economic growth increases the demand for human capital relative to conventional capital and that this increases the demand for high skills relative to low skills. I also shall contend that school systems differ markedly in their response to changes in the demand for schooling, and that there are in addition marked differences among students in their financial and related capacities to respond to such changes in the demand for skills.

To take my bearing, I plan to consider first some fragmentary evidence with respect to malinvestment in schooling and then classify the more important sources of such malinvestment. I will then proceed to the main purpose of this paper, which is to develop an approach for determining the responses underlying the investment in this form of human capital and attempt to derive from it some testable hypotheses which would explain the observable behavior of schools and students in responding to changes in the demand for skills that are a consequence of economic growth.

Afloat On Capital Heterogeneity

The connections between capital and growth are still unsettled despite the rapid growth of growth models. The reason for this unsettledness is fairly obvious; "capital" is ever so elusive analytically. The simplifying assumption that capital is homogeneous, although a useful device for preliminary exploration has been a disaster for capital theory, so Hicks tells us, for it is a metaphysical entity, "... a boat that is loose from its moorings... If there is just one homogeneous 'capital', there is nothing to do with our savings but to invest them in this 'capital'; there can be no problem of malinvestment."[1]

We know that there is malinvestment, but what is in store for us when we abandon capital homogeneity remains to be discovered. Capital heterogeneity, however, is no more than a raft that will stay afloat. The distinction between conventional (nonhuman) capital and human capital will not suffice, nor is a vintage specification applied to both classes sufficient. Nor is there much point to the game of treating capital either as jelly or as granite. The beehive now gathering knowledge with respect to human capital has already given us an array of different types of such capital. Even to list all of them would require a Sears catalog. Education alone is the source of many different forms. For elementary schooling we have profiles of workers with 0-4, 5-7, and 8 years of schooling by age, sex and color and these in turn by states, regions and the nation; and similarly for 9-11 and 12 years of schooling and up into college and for graduate work. We also can identify the value of the skills of engineers, doctors, lawyers, scientists and teachers. All of these different classes of skills, which are acquired as part of the process of attending school, are real and relevant as sources of productive services of value in production. We are fortunate in the United States with respect to data. We can identify and estimate the value of the productive services of many types of human capital attributed to schooling. It is noteworthy that our analytical job in undertaking such estimates is much easier than it is in estimating the value of the productive services of equipment, structures and most other forms of nonhuman capital.[2] Furthermore, the cost of the different types of human capital produced by schooling can be reckoned; nor are we committed to a fixprice family of models in determining the production or economic growth from these sources over time. In addition, it has been shown that education is amenable to treatment using the production function as an analytical tool.[3]

---

[1] John Hicks, Capital and Growth. Oxford University Press, 1965, p. 35.

Although most studies of human capital have not ended up in the homogeneity trap, the rate of return approach assumes as a rule a strong tendency to equilibrium. This assumption, however, can also become a trap. The strength or weakness of this tendency has not been tested. There may be circumstances, so it seems to me, under which this tendency could even be perverse for a considerable period of time. Thus, as I have already implied, the efficiency of the investment behavior underlying the formation of human capital awaits clarification. The evidence on malinvestment, for example in schooling, has not been examined systematically; the processes of response and the rate of response of each of these processes to changes in cost-benefits, or if you wish, to changes in rates of return are far from clear. How expectations are formed, how people act in response to changes in such expectations, how important are the institutional difficulties in this connection, and how schools lag in their adjustment to such changes - are largely unknown.

---

[2] Zvi Griliches and Dale W. Jorgenson, "Sources of Measured Productivity Change: Capital Input." Presented at the Winter 1965 Meeting of the Econometric Society. (Private circulation).

[3] Zvi Griliches, "Estimates of the Aggregate Agricultural Production Function from Cross-Sectional Data," Journal of Farm Economics, May 1963; "The Sources of Measured Productivity Growth (With Special Reference to U.S. Agriculture, 1940-1960)," Journal of Political Economy, August 1963; "Research Expenditures, Education, and the Aggregate Agricultural Production Function," American Economic Review, Vol. LIV, No. 6 (December 1964), pp. 961-974.

I. Clues with Respect to Malinvestment

Becker's first paper in this field asked the question, is there "Underinvestment in College Education?"[4] His then tentative findings showed relatively little underinvestment. Other studies have come to about the same conclusion for higher education, although for primary schooling the estimated rates of return are very high. Later studies then found that the rates of return to secondary schooling also were too high to warrant the inference that there had been no substantial underinvestment. For instance, in his book, Human Capital, Becker found that the private rate of return to high school graduates rose from 16 percent in 1939 to slightly more than 28 percent in 1958.[5]

Let me, however, postpone what can be inferred from these 'rate of return' studies and look at other evidence for indications of malinvestment. Does the fact that Western Europe has done well in terms of growth imply overinvestment in schooling in the United States? Unemployed elementary school leavers in poor countries might imply overinvestment. Relative high rates of unemployment in the United States could bias the estimated rates of return to schooling upward. There is an excess supply of particular skills. Conversely, depressed areas, a large component of U. S. poverty, the poor economic lot of American Negroes, and a substantial part of the inequality of income (earnings) between states and regions could be viewed as a consequence of long standing underinvestment in schooling in the states and regions with the lower earnings. Let me comment briefly on the possible relevance of these types of malinvestment.

---

[4] Gary S. Becker in American Economic Review, L (May 1960), pp. 346-54.

[5] Gary S. Becker, Human Capital, Columbia University Press, 1964, p. 128.

1. The Western European countries have achieved relatively high rates of growth during the post war years without nearly as much schooling per worker as prevails here and without difficulty in the case of Switzerland, West Germany and others in absorbing large numbers of unskilled workers from nearby countries. Does this European experience cast a doubt on the contribution of schooling to growth in modern, technically advanced countries? It is being so interpreted by some economists. The necessary comparative studies to test this view are not at hand. Some of these European countries entered the post war period relatively short on nonhuman capital. But this shortage should not have persisted so long. The national unemployment rates have in general been much lower than in the United States. But this fact could cut two ways: it would explain the job opportunities for the unskilled, but it might also have reduced the earning differentials between the low and high skills.

2. Unemployed elementary school leavers in the less developed countries are often cited as "proof" of overinvestment in elementary schooling. If such evidence were restricted to countries with a stagnant, traditional economy it should not come as a surprise. In poor countries with substantial economic growth, however, there is evidence that strongly supports the inference of underinvestment in education; as, for example, in Mexico[6] and in Northern Nigeria.[7]

---

[6] Martin Carnoy, Ph.D. research, "Cost and Returns to Schooling in Mexico," University of Chicago, 1964. (unpublished).

[7] Samuel Bowles, Ph.D. research, "The Efficient Allocation of Resources in Education: A Planning Model with Applications to Northern Nigeria," Harvard University, 1965. (unpublished).

3. A part of the recent difference in earnings in favor of labor, say, with 12 years compared to those with less than 8 years of schooling, has been a consequence of the relative high rate of national unemployment which permitted employers to ration jobs and in so doing to discriminate against less educated labor. Thus not all of the observed high rate of return - say to high school graduates - is to be taken as an underinvestment in such schooling since at least part of the observed rate of return is a result of national unemployment. But to return to Becker's estimates for high school graduates; in 1939 the rate of return was 16 percent and in 1956 it was 25 percent although the rate of unemployment had declined from 17 to virtually 4 percent.

4. It is often alleged that employers "buy degrees" instead of economic productivity in hiring workers, and thus schooling should be treated as a consumer good for employers. Although I mention this allegation, there is as far as I know no evidence to support it. Thus it cannot be considered a clue to malinvestment.

5. When we turn to particular skills, there is little doubt that there has been some overinvestment. Farming skills are surely a case in point, and in view of this fact, how much have the agricultural vocational departments in our high schools contributed?

6. Although our concept of a 'depressed area' is still vague, it might be useful to approach secularly depressed areas as communities which have relatively few skilled workers because they tend to be communities in which schooling is of a low quality and in which the number of years of school completed is substantially below par. Thus the school system in such areas produces relatively small numbers of skilled persons and most of them have been drained off, having migrated elsewhere. One inference to be drawn from this approach is that a secularly depressed area represents a special case of expost underinvestment in human capital.

7. In the case of poverty, also, viewed in retrospect, taking the long secular view and thus leaving aside cyclical changes in the rate of unemployment, much of the remaining poverty in the United States is a consequence of low earning capabilities which in turn is in large part a result of a lack of schooling. Thus interpreted, it represents past mistakes, expost malinvestment, that is, underinvestment at the time the particular persons who are now 25 years of age and older attended school.[8]

8. For a long time to come the low earning capabilities of adult Negroes in the labor force will depress their income even though rapid and real advances are made in eliminating job discrimination. Here, too, there have been serious long-standing mistakes in investing in their schooling, a legacy of underinvestment in human capital.

9. Lastly, I turn to education and the personal distribution of earnings. This clue, of course, cuts across several of those already considered above. Let me draw on Becker and Chiswick.[9] To explain the marked regional differences between the South and Non-South, they find that, "the greater inequality in the distribution of schooling in the South is presumably a consequence of the less equal opportunities even for whites there, and would only be strengthened by considering the differences in schooling between whites and nonwhites. The higher rates of return in the South are probably related to the lower education levels there... which in turn might be the result of inferior educational opportunities."[10] One-third of the inequality in earnings between states

---

[8] Theodore W. Schultz, "Investing in Poor People: An Economist's View," American Economic Review, LV (May, 1965), pp. 510-20.

[9] Gary S. Becker and Barry R. Chiswick, "Education and the Distribution of Earnings," presented at meetings of the American Economic Association, N.Y. City, December 29, 1965.

[10] Op. cit., p. 18.

is directly explained by schooling and other factors which together with schooling explain another one-third. Here, once again, we have evidence of underinvestment in schooling not restricted to the recent past but going back decades.

II. Classifying the Sources of Malinvestment

It would be elegant if there were a simple dichotomy, namely sources of malinvestment that are beyond the reach of economic incentives and sources that are within the realm of economic responses. But such a simplification is as yet not possible. Merely to list them calls for a preliminary exploration of the underlying investment processes which, to the best of my knowledge, has not been attempted. I would assume that any observable malinvestment is in large part some function of time and change. But what is the appropriate time horizon? Over a period of decades, I would suppose that even some social and political institutions are capable of adjusting; that is, they too will respond, for example in altering the system of schools of a country to meet the demand for new skills that are a consequence of economic growth. Thus in retrospect whether a particular malinvestment with respect to schooling could or could not have been avoided is not independent of the time span under consideration.

Looking back over the post-war period, I shall list what appears to be fairly obvious reasons for malinvestment in schooling. Such a classification of course rests on hindsight. I shall concentrate on institutional and demographic factors and on economic growth. Over a period this long, they of course overlap at some points and they are also interconnected.

1. Institutional factors. Our system of schools is institutionalized and so are the marked differences among them. There are also large differences in the opportunity for on-the-job training. Information relevant in making this class of investment is also subject

to institutional restraints. The state of the capital market is of special importance.

Our system of schools has a strong built-in institutional component designed to discriminate against particular classes of people. This legacy of discrimination along with its complement, job discrimination, has been responsible for much underinvestment in the schooling of Negroes, people with Spanish surnames, Puerto Ricans, American Indians and Filipinos. This legacy is a matter of preference of particular white people and it is supported by long established, social and political institutions.

State and local school systems have long been very uneven in the opportunity they provide to acquire achooling. Nor are the poorer opportunities restricted to Negroes and the other ethnic groups already mentioned. Fishlow has shown that large differences in this respect, for white children, were already evident before the Civil War; poor whites in the South were even then obtaining far less schooling than whites in the northeast and in the northern middle states. Although the amount of schooling has increased in all regions, it is still true that in general throughout the South most states and local political bodies provide less schooling both for whites and Negroes, especially so in terms of quality, than such political bodies provide in other regions.

The opportunity to invest in on-the-job training is exceedingly uneven and the reasons for this unevenness is also institutional in the sense that the structure of the economy is an institutional fact. Agriculture cannot provide any meaningful on-the-job training for farm youth who must seek nonfarm jobs. The growth industries that count most on this score are rarely to be found in small towns but instead they are located in and about the larger cities and urban centers. Then, too, the state of information with regard to the value of high skills is functionally related to the structure of the economy.

Lastly, then, I turn to the functioning of the capital market. It too is an established institution, and it is as yet poorly organized to supply funds to parents and students to invest in human capital. The reasons why this is true are obvious. But the consequences of this particular limitation of the capital market are less obvious. The principal result is that private investment in human capital is of necessity financed in large part internally from the resources of the family and the individual, largely through earnings foregone. This limitation in the way the capital market functions and the resulting dependency on internal family resources has the effect of making the differences in family income an important source of malinvestment.

2. Demographic factors. Most adult immigrants have been short on schooling but they have had to make the best of it, for it was in general too late for them to acquire what would have been the optimum amounts. Between 1941 and 1964, 3.7 million immigrants entered the U.S. who were 16 years of age and older; an occupational classification lists only 10 percent as "professional, technical and kindred workers." (Stat. Abstract 1965, Table 119.) In 1960 there were 447,000 foreign agricultural laborers, predominantly from Mexico, in the United States. The rate of population growth of Negroes, persons of Mexican nativity, farm people, and of poor people generally has been relatively high; but each of these groups has been up against special circumstances adverse to their investing in the schooling of their youth.

In retrospect there is no doubt that the age of laborers is an important key to malinvestment; the older the members of the labor force the larger the underinvestment per worker measured in years of school completed and, in addition, in the time spent in school per school year completed. For the oldest one-fifth, the equivalent schooling per worker is probably no more than half of that of the youngest one-half of the labor force.[11] Yet it may come as a surprise that Negroes have one demographic advantage in this connection and that is in the relative youth of the Negro population. One sees it most dramatically in the farm population of which the white had a median age of 31.9 years compared to that of 17.6 years for Negroes as of March, 1964.[12] Another demographic factor relevant here consists of the rise in female participation in the labor force and their schooling; older females in the labor force have had more schooling than males of comparable ages and, in the case of nonwhites, females are substantially better off than males in terms of schooling.

3. Economic growth. No long chain of economic logic is required to see that when the effects of growth upon factor prices are unanticipated the stage is set for malinvestment. In general, the growth industries have been the employers of high skills which require a long sequence of years of schooling. But it is hard to believe that parents and young people could have anticipated correctly, say two decades or so ago, the growth that has occurred since then in the production of consumer durables, of producer durables, and of the complex equipment and instruments demanded by the Pentagon and the Space Agency. These are, however, the industries that undoubtedly have accounted for most of the relative increase in producer demands for high skills. Even where the changes in the

---

[11] Theodore W. Schultz, "Education and Economic Growth," Social Forces Influencing Education, The Sixtieth Yearbook of the National Society for the Study of Education, ed. Nelson B. Henry (University of Chicago Press, 1961), Chap. III, , 46-88.

[12] Bureau of the Census, Series P-20, No. 142, Oct. 1965, Table 1.

relative size of the major sectors of the economy have been in large part a consequence of differences in the income elasticity of the demand for final products, they were not anticipated. For example, it was already well known two decades ago that the income elasticity of the demand for farm products was highly inelastic. While other changes also have occurred, I know of no economist who came even close to anticipating that the demand for human effort in agriculture would in terms of the size of the farm labor force decline by more than one-half, as it has since 1940.

Theplain fact of the matter is that even with hindsight we are not able to untangle the underlying factors that explain satisfactorily the recent past secular changes in these demands for skills. Until we can, we will not know how much they may tell us about future secular changes of the same general type. Are growth models the answer?

The birthrate of growth models has been very high, but they have not done well. They seem to lack the ability to comprehend the economic meaning of the nature of growth. Consider only the secular changes in the demand for skills. What part of these secular changes is revealed in consumer behavior? What part in producer behavior? The income effects of increases in consumer income upon the demand for final products are fairly clear, but as already noted we have no estimates of how these changes in consumption alter in turn the demand for skills.

Growth is in considerable part a consequence of new forms of capital. Yet the technical relations of such new factors to old factors are in general unknown. The connections between secular changes in factors and technical substitution and technical complementarity in production are still exceedingly vague; and thus there is no solid basis for specifying and identifying the effects of such changes upon the demand for skills. Are new high skills a substitute or a complement for new forms of nonhuman capital? My colleagues, Lewis and Welch, have ventured the hypothesis that in general they are complements. In addition it is plausible that both new high skills and new forms of nonhuman capital are substitutes for unskilled labor and for old forms of nonhuman capital. If true, it means that the new (high)skills acquired while attending high school and college are substitutes for unskilled human effort and for older forms of nonhuman capital; and, furthermore, that new forms of nonhuman capital increase the demand for these high skills and that high skills in turn increase the demand for new forms of nonhuman capital.

III. The Analytical Task

The response of schools and students takes on a special significance because investment mistakes in schooling are as a matter of fact more serious than investment mistakes in equipment and structures. Leaving aside the fact that schooling has a longer life and that investment in schooling is very much restricted to the early years of a person's life, there is a critical difference between them; namely mistakes in equipment and structures, if need be, can be abandoned and thus they become truly bygones, but human beings cannot be abandoned. It follows, therefore, that we should place a premium on finding ways to improve educational planning so that schools and students can avoid making avoidable investment mistakes.

To explore the response of schools and students to economic growth, it will be convenient to begin with the following simplifying assumptions with respect to the type of economic growth that has characterized our recent decades: (1) income per family increases, (2) inequality in the personal distribution of income decreases,

(3) the demand for high skills increases relative to that for low skills, and (4) the rate of obsolescence of skills increases. I also shall assume that schooling beyond the elementary grades entails substantial private costs which in general are not financed by the capital market but out of the personal income and assets of students and their families.

Institutions of higher education. The response of these institutions is of special interest because the increase in the demand for their services has increased more than it has for the services of high schools or for elementary schools, and because privately controlled institutions provide a larger share of the total services in the realm of higher education than in secondary and elementary schooling. Our assumptions clearly imply that the demand for higher education should increase more rapidly than the rate of increase in national income because in addition to the relative increase in the demand for high skills a larger proportion of families (students) were acquiring the necessary personal income and assets to pay the high private cost of attending college - tuition, extra board and room, travel, and most important earnings foregone. The assumption of a higher rate of obsolescence implies developing in students a capacity to renew and up-date their skills over time.

A rough gauge of the secular changes in the factors underlying our assumptions, except for the rate of obsolescence, is as follows: real income per family rose about two thirds between 1940-1962, the personal distribution of income by families became substantially more equal, and in spite of a doubling of the proportion of persons 25 years old and over who had completed four years of college, the college education rate of return stayed fairly constant and comparatively high. The implied high rate of increase in the demand has in fact brought forth a large increase in the aggregate supply of college places in our institutions of higher education. Between 1940 and 1962, the number of institutions increased by 329, almost by one-fifth, while the number of students for which they found places rose extraordinarily, increasing 2,232,000. Thus there were two and a half times as many student places in 1962 as in 1940. Accordingly, the supply of slots for college students increased by enough (leaving graduate students aside) to accommodate by 1962 in terms of undergraduate resident degree students one third of the population 18 to 21 years of age, compared to only 14 percent at the beginning of the forties. Rough as these measures are, the aggregate response of these institutions during this period of over two decades supports strongly the inference that our system of higher education is highly elastic as a supplier of more slots for college students.

But the aggregate response conceals a major difference between publically and privately controlled institutions in the rate of response. What factors determine this difference? Before considering the empirical evidence, what would be the expected rate of response of different classes of institutions?

If we had a system which would require every student to pay in full the marginal cost of his education and which for every qualified student who is too poor to pay this price would provide funds sufficient to make it possible for him to do so, the expectation would be that privately controlled institutions would prevail. Under such a system they would not only respond rapidly but it would be only a matter of time before they would predominate. They would prevail and predominate because the required decisions to do so would be more decentralized than those of publically controlled institutions and the incentive to do so would be direct and sufficiently rewarding to foot the bill to launch new institutions and expand the capacity of old ones.

As of 1962 such a system of higher education would have implied that on the average an undergraduate student would have had the means to invest $4,125 per year while attending college, of which $1,420 would have been tuition.[13] But it seems very plausible that most students attending college could not have afforded so large an amount. Then, too, with respect to tuition privately controlled institutions charged only about half of the cost they incurred per student.

The picture of response is, nevertheless, beset with puzzles. Why did privately controlled institutions respond at so high a rate during the first part of this period and then virtually not at all during the second part? Why did they resort increasingly to rationing devices other than by means of tuition during the later period?

Funds for expenditures and enrollment changes in higher education between 1940 and 1962 give added point to these puzzles.[14]

---

[13] These estimates were obtained by increasing my estimates for 1956 by one fourth. See my "Capital Formation by Education," Journal of Political Economy, 68, December 1960.

[14] Statistical Abstract of the United States 1965, Table 137.

(more)

	Privately controlled institutions			Publicly controlled institutions		
I. Enrollment	(thousands) (1)	(in percent) (2)	(3)	(thousands) (4)	(in percent) (5)	(6)
1940	698	100		797	100	
1950	1, 304	187	100	1, 355	170	100
1962	1, 514		116	2, 213		163
II. Expenditure	(million dollars)	(in percent)		(million dollars)	(in percent)	
1940	273	100		333	100	
1950	949	348	100	1, 174	353	100
1962	3, 095		326	3, 994		340

Clearly there was no appreciable difference in the rate of increase in funds for educational expenditures on the part of private and public institutions either during the first or the second period, whereas with respect to enrollment between 1940 and 1950 the privately controlled group expanded by 87 percent compared to only 70 percent on the part of publically controlled institutions. There then follows a marked change in the rate of response from 1950 to 1962 in providing additional places for college students, for they increased 16 and 63 percent respectively.

To explain these differences in response, I would venture the following hypotheses: (1) the marked rise in per family income from 1940 to 1950, along with the financial aid provided by Public Law 550 (G. I. benefits) made it financially possible for a larger proportion of college students to buy the services of privately controlled institutions for which they had a preference; and, these institutions entered the forties with what they considered to be "excess capacity." (2) After 1950 family income rose slowly and G. I. benefits had been exhausted which dampened somewhat the financial possibilities of students to pay private institution prices; yet more important were the decisions of those in authority of privately controlled institutions to expand the research function and to shift toward more graduate instructions for which additional funds were more readily available than for undergraduate instruction.

As we would expect from our assumptions with respect to economic growth, elementary schools and high schools have been responding to much smaller increase in the demand for their services. Between 1940 and 1962 both classes of schools expanded about 50 percent. But the pattern of response of privately controlled schools differs markedly from that of higher education. Between 1940 and 1962, for grades 1 to 8, enrollment in private schools rose 116 percent, and for grades 9 to 12, 145 percent. The enrollment picture for both the period from 1940 to 1950 and from 1950 to 1962 is shown in the data that follow:[15]

	Privately controlled schools			Publicly controlled schools		
I. Enrollment	(millions) (1)	(in percent) (2)	(3)	(millions) (4)	(in percent) (5)	(6)
Grades 1 to 8						
1940	2.10	100		18.2	100	
1950	2.58	123	100	18.4	101	100
1962	4.52		175	26.6		145
II. Enrollment Grades 9 to 12						
1940	.46	100		6.6	100	
1950	.67	146	100	5.7	86	100
1962	1.12		167	9.6		168

---

[15] Statistical Abstracts already cited, Table 137.

The students' part. Turning now to private investment in schooling by students and their families, the general outlines of the secular drift of the student demand for schooling can be inferred from the increase in the supply of places for students. There are, however, differences in the demand of students, in the price they pay, in their ability to pay, and in their pattern of response.

To simplify I shall abstract from the consumer component in schooling and assume that the student demand depends on the expected private rate of return on the investment which the schooling entails. But this expected rate of return is not a simple matter. It depends on a long, uncertain future, on the student's capability not yet put to test, on an array of changing costs, and importantly on the market for labor. Even for the same type of schooling and with all other factors equal except job opportunities, there are marked differences in the expected rate of return, for example, the difference between Negroes who will be up against job discrimination and whites who will not because they have the right surnames and religion, or the difference between females and males in this respect. There is a strong presumption that much of what is thought to be difference in motivation will turn out to be upon close analysis differences in the expected rate of return. What this means in the case of Negroes, is that they have had little or no economic incentive to investment in schooling because for them the expected private rate of return has been very low or even zero. Thus, clearly to eliminate one of the major causes of malinvestment in schooling it will be necessary to rid the labor market of discrimination.

Students and their families also differ markedly in the information they have for determining the expected rate of return that is relevant to their investment decisions. In general the poorer family the less well it will be informed. Within the same income class, rural families are worse off on this score than urban families. Among occupations, the professional class is undoubtedly best informed. It should be most worthwhile to reduce the inequality in the state of information in this area; the economics of doing so strongly supports making it a public enterprise.

But whatever the existing state of information its usefulness is subject to special qualifications. Uncertainty looms especially large, if for no other reason than the long life of the investment on which the expected rate of return depends. It is not possible to anticipate the shifts in the demand for particular skills for so long a period on ahead, or to anticipate the obsolescences to which particular skills will be subject. Such uncertainty calls for flexibility, even though it is not costless; it means investing in comprehensive schooling and postponing the acquisition of specialized skills to be acquired later on the job or during the latter part of the period of formal education.

The price of schooling is also elusive,partly because of large differences in the quality of schooling and partly because of variations in tuition, in the cost of the additional board and room, and in earnings foregone. The apparent price is lower in public than in private schools. In higher education, it is lowest in the West and highest in the East and lower for junior colleges than for other classes of institutions. Considering both regional and type of control differences, tuition during 1963-64 ranged from $68 to $713 for junior colleges and from $232 to $1418 for universities.[16] Although private costs are less than real factor cost, the difference in the price of schooling to students is much less than might be inferred from the difference in factor cost that is not borne by students because of the fact that earnings foregone are so large a part of the total price. It is probably true, although ironical, that differences in earnings foregone still swamp other cost differences because of job discrimination confronting Negroes and some other classes of families.

---

[16] Digest of Educational Statistics 1965, Table 79.

Yet despite all of the difficulties inherent in determining the relevance of the expected rate of return including the price of schooling and the overall poor information on this matter, the investment behavior of students indicates that they respond to the changing differences in these expected rates of return. But the patterns of response are undoubtedly influenced strongly by differences in the ability of students to pay. On the assumption that the capital market is still in general not prepared to finance this type of capital formation, the differences in private resources - personal income and assets - play a critical role in determining the difference in ability to pay. The secular rise in the personal income of families is therefore a major factor in making it possible for a larger fraction of the school age population to pay the price of continuing in school through high school and on into higher education. Yet obviously many qualified students still lack the ability to pay.

But the secular changes in the demand for skills remain unresolved analytically. The heart of this riddle is in economic growth. To solve it is the uncompleted part of this paper.

Chapter ___

EDUCATION OF THE LABOR FORCE

In my study of the United States I found the increase in the education of the labor force to be one of the largest sources of growth from 1929 to 1957, mainly because an enormous increase in the quantity of education took place. This chapter attempts to measure the improvement in the quality of labor that resulted from increased education of the labor force in the 1950-62 period in the countries covered by this study. Comparisons of the quality of labor are also attempted between countries. Both types of estimate are rough because of limitations of information and technique, but the intertemporal comparisons must be judged much more satisfactory than the comparisons of levels in different countries.

Educational background conditions both the types of work an individual is able to do and his efficiency in doing them. It is a crucial determinant of the quality of labor. To count high school or college graduates as only the same amount of labor, on the average, as elementary school graduates of the same age and sex would be altogether unsatisfactory. They earn more and contribute more to the national product. If workers with one level of education earn 50 percent more, on the average, than otherwise similar individuals with less education, they will be counted in this chapter as 50 percent more labor. The reason is by now familiar: differences between average earnings of large groups of individuals may be taken as measures of differences in the value of the average of their marginal products. In all the countries considered here there has been a gradual upward movement of the distribution of the labor force by level of education. This has meant that the skills and versatility of labor were upgraded, and this increase in the quality of labor has been an important source of increase in national income.

The estimates derived in this chapter do not measure the total direct and indirect effects of education on output and growth. They are intended to measure only the effect of additional education on the average quality of labor, and to provide a basis for calculating the contribution that this improvement has made to the growth rate. The distinction can be clarified by explaining the relationship between education and other growth sources in the classification that I follow.

1. It is essential to distinguish between (a) society's stock of knowledge relevant to production, which (along with other conditions) governs the output that is obtained with given inputs, and (b) the quantity and quality of inputs (including the education of the labor force) which govern the output that is obtained with a given stock of knowledge.

New inventions, new ways of organizing production, improved business practices, and the like increase the output that can be obtained with given inputs. Increases in output obtained in this way are credited in my classification to "advances in knowledge," not to education, even if the education of the labor force in general, or the number of highly educated individuals in particular, influences the pace of such advances.

2. A better educated work force -- from top management down -- will be better able to learn about and to utilize the most efficient production practices known. The effect of education on this ability is one aspect of the quality of labor that is measured here, insofar as it is reflected in earnings differentials. Consequently, the growth source,

"changes in the lag of actual practice behind the best known," does not include changes brought about as an incidental result of changes in the amount of education of the labor force but is confined to the effects of other changes, such as improved channels of information, and opportunities to observe the practices of other firms or countries, and of changes in the age of the capital stock.[1] I would not pretend the distinction is precise, but it is clear enough for general understanding.

3. Individuals in school usually do not work, and those who do usually work part-time. Hence extending the length of education influences at least three measures of labor input that we have already examined: employment is reduced, average hours of work may be lowered, and (since the proportion of young people in the labor force is reduced) the age composition is improved. The net effect of these three changes is to reduce total labor input while raising the average quality of labor.[2] We do not

---

[1] Advances in knowledge of course change the content of education; what is taught in a physics or economics course today is not what was taught a generation ago, and this is one of the main ways in which new knowledge is disseminated. If what is taught in schools and colleges lags further behind, or approaches more nearly, the current state of the arts this can influence "changes in the lag of actual practice behind the best known." It is not reflected in my education measures, which take no account of the content of courses.

[2] There may be, much later, an offset to these effects in that highly educated persons are likely to retire later than others, and in the case of women are more likely to be in the labor force throughout their lives.

trace these effects back to education, but leave them classified as effects of employment, hours, or the age-sex composition of employment.

It should be noted that the timing of these effects depends on changes in the education of the young, which bears no close relationship to changes in the average education of the labor force.

4. As education is extended, the age at which young people enter the labor force rises. This means that, in any age group, the more educated individuals have had less work experience than the less educated. In measuring the effect of education on the quality of labor, we measure the excess of the benefit from longer education over the associated loss from curtailed work experience.[1]

5. Among the benefits of additional education, especially general education, are presumed to be increased versatility, mobility, and awareness of employment opportunities. Among the subsidiary reasons that individuals with more education earn more than those with less education is that they are more likely for these reasons to be employed where, given their abilities, their marginal value products are greatest. If they lose their positions because of shifts in the demand for labor, they are likely to be able to shift to alternative jobs with less (if any) reduction of earnings

---

1. As will be seen below, this is accomplished by basing the weights for individuals with different amounts of education on earnings differentials based on age groups rather than length-of-experience groups.

Why are the better-educat
more mobile? Because their
incomes are higher ?

and less loss of time in unemployment.[1] These advantages of education are counted in our education quality measure.

The Shape of Educational Distributions

The distribution of the labor force by amount of education in the United States differs radically from distributions in Northwest Europe, and the Italian distribution is very different from both. Knowledge of the shape of the distributions is necessary background for the ensuing discussion.

Distributions of males by years of education are given in Table 1. Females in the labor force are a little more educated than males (except that fewer hold university degrees) in the Anglo-Saxon countries, usually a little less on the Continent, but the contrasts between countries are generally similar to those for males.[2] Table 1 does not compare identical dates, but this has little effect on a comparison of the shape of the distributions.

---

1. In the United States the unemployment rate drops almost steadily with a rise in level of education, and is almost 7 times as high for those with less than 8 years of education as for those with 16 years or more. For a discussion of this point see R. A. Gordon, Has Structural Unemployment Worsened?, Institute of Industrial Relations, University of California, Berkeley, 1964, pp. 70-75, and the references to the work of C.C. Killingsworth he cites.

2. Girls tend to remain in school longer than boys in the Anglo-Saxon countries, and females in the labor force are, on the average, younger.

Table 1

Percentage Distributions of the Male Labor Force in Four Countries by Years of Education

Years of Education	United States 1957 [1]	France 1954	United Kingdom 1951	Italy 1961
0	1.4	.3	.2	13.7[3]
1-4	5.7	2.4	.2	26.1[3]
5-6	6.3	19.2[2]	.8	38.0[4]
7	5.8	21.1	4.0	4.2
8	17.2	27.8	27.2	8.1
9	6.3	4.6	45.1	.7
10	7.3	4.1	8.4	.7
11	6.0	6.5	7.3	.6
12	26.2	5.4	2.5	1.8
13-15	8.3	5.4	2.2	3.0
16 or more	9.5	3.2	2.1	3.1

1. The United States distribution is not adjusted to take account of the fact that, in the past, the same number of years of education represented less school attendance than it now does.

2. Largely at 6 years.

3. As indicated subsequently in the text, the percentage with 0 years probably is overstated and the percentage with 1-4 years correspondingly understated.

4. Consists of 33.8% at 5 years and 4.2% at 6.

The dominant feature of Northwest European distributions, as illustrated by the United Kingdom and France, is extreme concentration at a level governed by past legal school attendance requirements. In the United Kingdom fully 72 percent of the 1951 labor force had either 8 or 9 years of education. These durations correspond to the legal requirement for school attendance from age 5 to 13 at the time the older age groups had attended school, and 5 to 14 when the younger age groups attended school. (The 1947 increase to 15 affected only the very youngest age group by 1951.) Few escaped the legal requirement; only 5 percent had less than 8 years of school, and most of these had 7 years. On the other hand, only the exceptional worker had remained in school after the law allowed him to leave (unlike most countries, it did not require him to complete the school year) and very few continued after the extra year readily available to all. Of the male British labor force only 16 percent had 10 or 11 years of education and a scant 7 percent 12 years or more. Even now most British children leave school as soon as legally allowed. In 1957-58 only 40 percent each of British boys and girls 15 years old, and 22 percent of 16-year olds, were receiving full-time education.

Extreme concentration also characterizes the French distribution. There were, however, the following differences. First, because the French student started a year later than the British student and (at most dates) left at the same age, the concentration is at 7 and 8 years of education rather than at 8 and 9. In addition, more of the French labor force fell below the level that the legal school-leaving age would seem to yield. Even so, about two-thirds of the French labor force had 6 to 8 years of education. Third, in both countries just under one-fourth had 10 or more years of education, but in the United Kingdom 16 percent had 10 or 11 years and only 7 percent 12 or more, while in France 11 percent had 10 or 11 years and 14 percent 12 or more. France thus had about twice as large a percentage at the level that includes graduates of high schools, universities, teachers colleges, and technical institutes.[1]

The tendency to leave school as soon as allowed may never have been quite as strong in some of the Continental countries as in the United Kingdom, and clearly is breaking down more rapidly in some of them. In France, only 5 percent of the children continued after compulsory schooling (then completed at age 13) in 1914, but by the 1950's 65 percent were continuing after compulsory schooling (then completed at age 15). By the immediate postwar years, 68-70 percent of the 14- and 15-year olds in Belgium (where 14 has been the school-leaving age since 1914) were in school and the percentage has been rising about one point a year. In Germany, however, only 28 percent were continuing full-time education after the 8 or (in Länder with one-ninth the population) 9 years required.[1]

---

[1] France had half again as many as Britain with 16 or more years of education. From Tables in Part V of Appendix IV of Higher Education, Committee on Higher Education, Cmnd. 2154-IV, HMSO, London, 1963, one can derive an estimate that, in 1961, 1.6 percent of the British male labor force had obtained the equivalent of some higher education through part-time courses or private study. If all of these were transferred from 13-15 to the 16-plus group (which could hardly be justified) and no adjustment were made for France, the British percentage at the 16-plus level would equal the French but the comparison in the text would be unaffected.

The Italian distribution is also highly concentrated, but the concentration occurs at the bottom of the distribution, corresponding to compulsory education of only three years when the older age groups were in school, and five or six when the younger age groups (except the very youngest) were in school. Lax enforcement and inadequate school facilities accompanied the low school-leaving age. Nearly three-fourths of the whole male labor force in 1961 had 5 years or less of education. In Italy alone among the countries considered in this study illiteracy is still significant. The Italian distribution has a small secondary concentration at 8 years, corresponding to the "Licenza di scuola media inferiore"; a nearly complete gap in the 9-11 year range (which includes only the estimated number starting but not completing work for a diploma); and, perhaps surprisingly, numbers with 13 or more years of education that lie between the French and British figures.

To an American, the most extraordinary feature of all the European distributions is the paucity of people who have completed secondary education without continuing to advanced education. In fact, in some countries hardly anyone who did not plan to go to the university entered an advanced secondary course. Even now the proportion of secondary school graduates (itself a very small fraction of the appropriate age group) who do not actually enter higher education typically ranges downward from around one-third; it is about one-fifth in France and Germany. The proportion is almost one-half (of a vastly larger number completing secondary education) in the United States.[1] The European distributions are remarkably lacking in individuals corresponding to American high school graduates.

---

[1] The figures cited in this paragraph are from EEC, *Formation professionnelle des travailleurs qualifiés dans les pays de la CEE*, Brussels, 1963 (mimeograph). Similar figures given above for the United Kingdom are from *15 to 18* (Vol. I, Report); HMSO, London, 1959.

The distribution of the United States labor force bears no resemblance to the European distributions. Educational background is remarkably diverse. There is but little concentration at any one point or in any narrow range. Whereas a three-year span can cover two-thirds of the distribution in France and three-fourths in the United Kingdom, only 40 percent of the American male labor force can be covered in any three-year span (at 10 to 12 years). Large numbers appear at the lower and upper ranges of the distribution as well as in the middle. Nearly one-fifth had 7 or fewer years of education, many of them much less. Almost as large a fraction had 13 or more years, representing at least one year of college completed; almost one-tenth had graduated from college, and nearly half of these had one or more years of graduate work. In the middle, 17 percent had 8 years of school, 20 percent were about equally divided among the 9, 10, and 11 year levels, and 26 percent had 12 years.

The great dispersion in the United States reflects in part, and especially at the bottom, the past variation among states, and over time, in school attendance and child labor laws, and their lax enforcement. Far more important in determining the distribution as a whole, however, is the fact that compulsory school attendance laws have not been, and are

---

1. See Organisation for Economic Co-operation and Development, *Resources of Scientific and Technical Personnel in the OECD Area* (Paris, 1963), pp. 70-74, 82-83.

not now, decisive in governing the time at which most Americans leave school; if they were, most Americans would now end their education on their sixteenth birthday after 9 or 10 years of schooling. Such concentrations as occur in the distribution correspond to completion of some type of school. These fall at 16 years for college, 14 for junior college, 12 for high school, 9 for junior high school, 8 (formerly 7 in the South) for older-type elementary schools, and 6 for the newer-type elementary school.

Extremely important in the American scene has been the availability of free public education far beyond the requirements of school attendance laws. But this would have accomplished little unless the opportunities were freely grasped. To a great extent they were, because of the widespread faith of American parents that education is the key that opens the door to future advancement; the child should and could rise above the station of the parent, and the way to do so was to obtain more education. The process was, of course, cumulative. Faith in education led to the demand for free public schools and colleges available to all, availability facilitated the rise in educational achievement, and this led to a rise in the level considered normal or necessary. But this process created not uniformity but great dispersion of the length of education in each age group, and of course great differences among age groups.

Calculation of Quality Indexes

The calculation of indexes of the effect of education on the quality of labor requires two types of information. First, we require a set of weights to combine individuals with different amounts of education. Is a college graduate to be counted as the equivalent of 1-1/2, 2, 3, 4 or 5 elementary school graduates? Second, we require distributions of the labor force, by amount of education, at different dates, to which these weights may be applied.

The Weights

Suppose the United States labor force is divided into educational groups consisting of college graduates, those with 1 to 3 years of college, high school graduates, and so on, according to a classification like that given in Table 2. The selection of weights for each group would be simple if the members of each group differed only in education and were similar in all other respects that affect earnings -- that is, if they were divided in the same proportions by age, sex, native ability and energy, family background, and so on. In that case the average earnings of members of each group, taken as measuring their marginal value product, would provide the appropriate weight. If the average earnings of college graduates were double those of high school graduates, one college graduate would be counted as the equivalent of two high school graduates. But the different education groups do differ substantially in other respects, so the selection of weights is more difficult. We must try to eliminate the effects of these other differences.

United States Weights. For the United States we start with estimates that already eliminate the effects of differences in sex and, approximately, age.

Table 2

United States

Income Differentials by Years of Education, 1949: Average of Selected Age Classes of Males

Highest Level of School Completed	Usual Number of Years of Education	Mean Income as Percent of Mean Income of Eighth Grade Graduates (1)	Mean Income Differentials Used to Represent Education (Percent of Income of Eighth Grade Graduates) (2)
None	0	50	70
Elementary School:			
1 to 4 years	1-4	65	79
5 to 7 years	5-7	80	88
8 years	8	100	100
High School:			
1 to 3 years	9-11	115	109
4 years	12	140	124
College:			
1 to 3 years	13-15	165	139
4 years or more	16 or more	235	181

The average income of males in the labor force cross-classified by highest school grade completed and age is known for 1949. For each age group, the average income of persons in each education group was expressed as a percentage of the average income of those with 8 years of education. The percentages for the several age groups were then averaged to obtain the distributions shown in Column 1 of Table 2.[1] The data refer to reported money income, rather than to earnings, but it is clear from other evidence that this has so little effect on the differentials that the percentages may be taken as representative of earnings from labor.

Differences in education and the loss of work experience associated with additional education clearly are not the only differences that distinguish the education groups. Hence the differences in average earnings cannot be used without adjustment to measure earnings differences that are due to differences in education and associated loss of experience. The higher the education group, the higher is the proportion of individuals who obtained high marks in earlier schooling, who scored well on standardized intelligence tests, who attended the better schools, and whose parents were themselves well educated and had substantial incomes. After examining the available information, I decided in my United States study to assume that three-fifths of the reported income differential between each of the other groups and the group with 8 years of education represented differences in earnings due to differences in education as distinguished from other associated characteristics. This assumption yielded the adjusted differentials

---

1. The distribution is an average of separate similar distributions for the age classes 25-34, 35-44, 45-54, and 55-64. Since the data include persons not in the labor force, age groups which include substantial numbers not in the labor force could not be used.

shown in the second column of Table 2. These were used for weights in my United States study and I use them again in my present study. Taking the labor of a person with 8 years of education as one unit, I count the education of a person with no education as .70 units, of persons with 12 years of education as 1.24 units, and so on.

The three-fifths assumption on which these weights rest was originally based on no statistical foundation but only a general impression derived from examining the characteristics of different education groups. Some support for the differentials used in the upper range of the distribution was, however, subsequently obtained from an analysis of data collected by Dael Wolfle and Joseph P. Smith for 1953 earnings of male high school graduates of the mid-1930's for whom high school records and respondents' answers provided a great deal of collateral information.[1] The survey made possible an effort to isolate the effects of differences in education on income from the effects of the more important measurable associated variables: rank in high-school class, intelligence test scores, father's occupation (taken as an indication of family background), and geographic area (which to a considerable extent removes the effect of quality of high school and of race). After removal of the influence of these associated variables, the analysis indicated that in comparison with high-school graduates without college education (but including those with other types of further education), 1 to 3 years of college added 13 percent and 4 or more years of college 45 percent to average earnings. The corresponding percentages calculated from Column 2 of Table 2 are 12

---

1. The analysis is given in Proportion of Income Differentials Among Education Groups "due to" Additional Education: the Evidence of the Wolfle-Smith Survey, a supplement to the paper I presented at the May 1963 meeting of the Economics of Education Study Group of OECD.

and 45. The analysis of the survey results is by no means definitive or precise. It does, however, give fairly strong support to the general size of the differentials used in the range above high school.

The survey analysis suggested that two-thirds of the salary differential of college graduates over the high-school group is "due to" education.[1] Table 2, which is based on the assumption that three-fifths of the differential between every other group and the 8th grade group is "due to" education, also happens to imply that two-thirds of the differential between high school and college graduates is "due to" education. The experiment was made of using the survey analysis for differentials above the high-school level, and assuming that up to the high-school level two-thirds of the differential of earnings at each educational level distinguished (as given in Column 1 of Table 2) above earnings at the next lower level was "due to" education. The resulting differentials are almost identical with those given in Column 2 of Table 2, except that the weight for the "no education" group, which is applied to very few people, would be raised from 65 to 70.

Even though the number of college graduates has risen much more rapidly than the number of high-school graduates since 1949, there has been some tendency for the income differential between the two groups to widen.[2]

---

[1] It may be noted that the results cited here refer to what I considered the best way to analyze the Wolfle-Smith survey results; an alternative procedure that I also explored allocated higher fractions of the crude differential to education as distinguished from associated variables.

[2] See: Herman M. Miller, "Annual and Lifetime Income in Relation to Education," American Economic Review, December 1960; Edward F. Denison, OECD paper; and James Morgan and Charles Lininger, "Education and Income: Comment," Quarterly Journal of Economics, May 1964.

If there is a change at the lower levels, it is also in the direction of widening differentials. Apparently the pattern of demand for persons with different amounts of education has been shifting toward the more educated groups even more rapidly -- to be on the safe side, I should prefer to say at least as rapidly -- as the supply. There would, therefore, be some justification for using wider differentials in the education weights for the latter part of the 1950-62 period than at the beginning, but in view of the imprecision of the estimates the additional work did not appear to be warranted.[1]

The education weights derived for males are also used for females, in the absence of separate information.[2]

European Weights. It is impossible in the present state of knowledge to try to derive separate sets of weights for the education groups in each of the individual Northwest European countries. At best we can hope only to select one set of weights that is reasonably representative of Northwest Europe.

---

[1] In the OECD paper just cited I note the possibility that in the lower part of the distribution differentials in natural ability and other associated variables may be widening, so that the differentials that measures earnings differences "due to" education may not be increasing or may even be declining.

[2] Since females receive only about one-fifth of the weight in the calculations (see below), this assumption is unlikely to cause serious error. Mary Jean Bowman states that "the ratio of the average income of the better-educated women to the female average wage tends to be lower than the comparable ratio for men" but does not discuss the full distribution. ("Schultz, Denison, and the Contribution of 'Eds' to National Income Growth," The Journal of Political Economy, October 1964, p. 458.)

As already noted, the labor force in Northwest Europe is far more concentrated in the middle of the educational distribution than is the American labor force. In particular, the proportion of individuals with education beyond the minimum legal requirement is very much smaller than in the United States. For this reason larger earnings differentials due to differences in education may be expected in Europe, provided (as seems reasonable) that the pattern of demand schedules for different types of labor is at all similar. Because the choice of students to secure advanced secondary education and higher education probably has been more selective with respect both to ability and family status, earnings differentials among education groups due to factors other than education may also be expected to be larger in Europe. Hence we should expect observed earnings differentials between education groups to be still larger, in comparison with the United States, than those due to education as such.

There are, at the time of writing this preliminary draft, almost no European data for average earnings of individuals classified by amount of education. A survey being conducted by the I.N.S.E.E. will, it is hoped, provide for France information of this type that can be utilized in the final version of this study. A German Microcensus survey for April 1964 should also be helpful when tabulations become available. I anticipate that I shall eventually use these data. In the meantime there are only two relevant sources of which I am aware.[1]

---

[1] I ignore here some Dutch data from which an ingenious investigator intimately familiar with the statistics could probably derive some inferences.

E. Malinvaud, in commenting upon a paper I presented at the May 1963 meeting of the OECD Study Group on the Economics of Education, suggested that the education weights that I used for the United States would also be reasonable for France through 9 years of education. He suggested weights of 125 instead of 115 in the United States for those with 10 or 11 years of education, 170 instead of 135 for 12-15 years, and 300 instead of 181 for 16 years or more.[1] With rough adjustment to different class intervals, Malinvaud's suggested differentials for France, and my corresponding United States differentials, are given in the first two columns of Table 3.

Let me stress that these French estimates represent only the judgment of a competent and knowledgable observer. They were used by Malinvaud when attempting precisely the calculation I now attempt, that is, application to France of the methodology I used for the United States, but they are not based on statistical information. Malinvaud himself is, I believe, largely responsible for the study of French differentials now in progress. Until actual data become available, I shall accept Malinvaud's estimates for France, and use them also for the other European countries.

---

1. The United States figures given are Malinvaud's adjustments of my estimates to different class intervals.

On grounds of relative supply, differentials between the bottom and the middle of the distribution might be expected to be smaller in Northwest Europe than in America. However, few members of the labor force in Northwest Europe fall below 6 or 7 years, so the differentials at the bottom of the range are not important in the weighting system for calculation of quality adjustment indexes over time for the European countries. They are of somewhat greater importance if an international comparison of the United States and Northwest Europe based on Northwest European weights is attempted.

Table 3

Weights Applied to Different Education Groups in This Study

Years of Education	United States	Northwest Europe	Italy
0	70	70	50
1-4	79	79	65
5-7	88	88	80
8	100	100	100
9	109	106	119
10-11		125	
12	124	148	148
13-15	139	178	178
16 or more	181	300	300

A study for Belgium strongly confirms that differentials in Europe are much larger than in the United States. The Working Group for the Study of Human Capital at the Department of Applied Economics of the Free University of Brussels (of which Professor Max Frank is Chairman) undertook a study of the contribution of education to Belgian growth broadly similar to mine for the United States.[1] They divided the male Belgian labor force among five occupational categories, based on skill and earnings levels, and attempted to estimate the usual or average earnings of each level (Column 3 of the following table). They then set down the educational certificates or degrees typically held by members of each class. For example, those in Class I typically have a 6-year primary education and 1 or 2 years of lower secondary education. Those in Class V typically have a university education. For comparison with other data, I have translated the degrees into approximate years of education (Column 2).

The Study Group assumed 3/4 of the differential between the average earnings of the lowest group and those of other groups to be "due to" education. A figure above my 3/5 was chosen deliberately in the belief that certificates and diplomas have a greater effect upon earnings in Belgium than in the United States. They thus arrived for Belgium at the differentials given in Column 4. They are even larger, by a considerable margin, than those used by Malinvaud for France.

---

[1] "L'Education et la croissance économique en Belgique," Cahiers économiques de Bruxelles, No. 24, 4th quarter of 1964, pp. 501-523.

Occupational Level	Usual Years of Education	Earnings Index (1st Level = 100)				
		Income Differential	3/4 of differential over Group I	3/5 of differential over Group I	Half of differential over Group I	Two-thirds of differential over preceding group
(1)	(2)	(3)	(4)	(5)	(6)	(7)
I	7-8	100	100	100	100	100
II	9	130	123	118	115	120
III	12	251	213	191	175	194
IV	14-16	349	287	249	225	244
V	16 or more	502	401	341	301	315

It seems to me, however, that the Belgian differentials are likely to be overstated, at least in comparison with those I use for the United States. This is partly because I doubt that a higher fraction of the observed differential should be ascribed to education in Belgium than in the United States.

In Columns 4 to 6 of the preceding table, I compare the results of using for Belgium fractions of 3/4, 3/5, and 1/2 of the differential over Group I earnings. If we conceive the observed earnings differential as the product of differentials due (1) to education and (2) to native ability, family status, and other associated variables, we can compute the differentials implied for each under the alternative assumptions. If we roughly equate Belgian levels I, III, and V with 8, 12, and 16 or more years of education, we also obtain comparisons with the United States.

Years of Education	Differential Due to Education Alone				Differential Due to Other Variables Alone			
	United States	Belgium			United States	Belgium		
	(3/5 Assumption)	3/4	3/5	1/2	(3/5 Assumption)	3/4	3/5	1/2
12 years/8 years	124	213	191	175	113	118	131	143
16 years or more/8 years	181	401	341	301	130	125	147	167
16 years or more/12 years	146	188	179	172	115	106	112	116

On a priori grounds both the differentials due to education and those due to other variables should be larger in Belgium than in the United States. With an allocation of 3/5 in the United States and 3/4 in Belgium, this test is not met by the differentials for "other variables" between those with 16 or more years of education and those with either 8 or 12 years.[1] It is met with Belgian allocations of either 3/5 or 1/2 (except for the comparison of the 16 with the 12 year levels on the 3/5 assumption). Even a 50 percent allocation yields results that conform to the expectation of the Belgian group (and myself) that the effect of education on earnings is much greater in Belgium than in the United States.

If the original earnings differentials in the two countries were comparable my own inclination, in the absence of further evidence, would be to use for Belgium education weights obtained on the assumption (consistent with though not identical to my American procedure) that two-thirds of the crude differential of earnings of each of the groups over earnings of the preceding group is "due to" education. Differentials so computed are given in Column 7 of the table on page 22. When some rough allowance is made for the difference in classification (Group I includes those with 7 years of education, and those with 16 years are divided between Groups IV and V) these estimates appear to imply about the same differential as Malinvaud's between those with 8 years of education and those with 16 years or more. However, they yield larger differentials between the 8-year group and the intermediate groups, and smaller differentials between the intermediate groups and the highest group.[1]

---

[1] It may be noted that the assumption that 3/4 of the differential between Group I earnings and those of the other groups is due to education actually implies that 88 percent of the differential of Group V earnings over "Group III" earnings is due to education.

My reason for not using the Belgian data at this time is a suspicion that the original earnings obtained in the study may overstate differentials between the specific years-of-education groups I have labeled. One reason for this suspicion is the apparent implication of the data (when they are combined with estimates of average earnings in the two countries) that real earnings of high-school and college graduates in Belgium substantially exceed the earnings of their counterparts in the United States. This seems unlikely to be the case.[2]

---

[1] On balance, use of these differentials would yield a greater rise over time than Malinvaud's in the quality indexes that will be computed, and in this sense may be said to be wider.

[2] Also to be noted is the fact that considerable use was made of minimum wage rate schedules in deriving the earnings estimates, and that the main data used related to occupational category rather than to education as such. However, the Belgian investigators were aware of these difficulties and tried to surmount them, so my suspicion that these characteristics lead to overstatement of differentials may be unfounded.

There is also one possibility of an opposite bias. Unlike my American estimates, the Belgian estimates combine all age groups (except that the

The Belgian data despite all qualifications very strongly indicate that differentials due to education are much larger in Europe than in the United States, and give some reason for believing that, at least when applied to Belgium, Malinvaud's differentials may be on the low side.

The educational levels and distributions in the Northwest European countries are sufficiently similar to make use of the same weights for all the countries appear at least plausible. The Italian distribution, on the other hand, is very different. Adults with even 7 or 8 years of education comprise a select group in Italy, the bulk of the labor force being below this level. Much larger earnings differentials therefore seem probable at the lower end of the distribution. Weights assigned these groups have a far greater effect on the calculations in Italy than in the United States or, especially, Northwest Europe. For Italy, I shall use the Northwest European differentials above the 8-year level, and below that level -- quite arbitrarily -- the United States earnings differentials before adjustment for correlation with other variables. The differentials below the 8-year level are thus 5/3 as large as those used for the United States and Northwest Europe.

---

wages for certain salaried employees, as distinguished from wage earners, refer to those under 35 years of age). This would be one factor tending to introduce a bias in the opposite direction if the Belgian data were actually based on a classification by amount of education as such; since age and amount of education are negatively correlated, the more summary procedure leads to lower differentials than when the data are first classified by age. Given the actual Belgian procedures, however, this bias seems unlikely to be significant.

In all cases the male percentage differentials are used also for females. This implies that absolute differentials for females are much smaller than for males, since average earnings of females are much lower.

It will become apparent that the larger the differentials in the weighting system adopted, the more a quality adjustment index will rise over time as the education of the labor force increases. If the differentials are too large, the index will rise too much; if too little, not enough. Also, the size of the error in a quality adjustment index that results from errors in the weights is related directly to the change in the quality index. For example, if the differentials in the weights used were uniformly only two-thirds as large as they should be, and if for two countries we estimate that the quality of labor increased 2 percent and 4 percent, respectively, as a result of increased education, then the "true" changes would be 3 percent and 6 percent.

Distributions of the Labor Force by Amount of Education, and Computation of Quality Indexes over Time

Calculation of quality indexes for education requires distributions of the labor force by amount of education in the years to be compared, to which these weights can be applied. These distributions are needed separately for males and females, so that separate quality indexes can be computed for each.

If distributions of the labor force of each sex, classified in terms of an unchanging measure of educational attainment, were available for each of the key years that concern us (1950, 1955, 1960, and 1962) computation of education quality indexes for males and females would be simple. We would calculate the average quality of each sex in each year by weighting the proportion in each education group by the weight for that group in Table 3. The estimates for males and females would then be converted to indexes, with 1960 equal 100. More complex procedures were actually required to approximate the indexes for males and females that would be obtained by this procedure, and there is inevitably some question as to whether the measures of education used are actually unchanging.[1]

The separate indexes for males and females are combined by the labor input (earnings) weights for 1960 derived in Chapter __. In addition, an index for the armed forces (taken always as 100 since the output measures do not allow for differences in the quality of labor) is weighted in. The weights used are given in Table 4; they are similar to those given for the United States and Northwest Europe in Table 6 of the preceding chapter.[2] Females, of course, receive a weight much smaller than their share in the labor force, and the movement of the quality indexes is dominated by the indexes for male civilians.

---

1. In the text I give only a broad picture of the approach and the quality of the data. The estimates are described in detail in Derivation of Tables in Education Chapter.

2. Full consistency with the preceding chapter would have required separate educational quality indexes for three age groups within each sex. However, this further refinement was not practical. Such more refined indexes would presumably tend to lag slightly behind those computed here because the youngest age group has the lowest earnings. In the unlikely event of a sudden sharp break in the growth rates of the education quality indexes this could disturb the timing of the change.

Table 4

Percentage Distribution of Labor Input in 1960

	Male Civilians	Female Civilians	Military Personnel
United States	77.9	18.9	3.2
Northwest Europe	77.3	20.6	2.1
Belgium	79.3	18.1	2.6
Denmark	76.3	21.7	2.0
France	75.5	20.6	3.9
Germany	75.5	23.6	.9
Netherlands	84.6	13.1	2.3
Norway	81.8	15.8	2.4
United Kingdom	78.9	19.3	1.8
Italy	82.4	16.0	1.6

Table 5

Estimation of Education Quality Indexes in the United States

	Preliminary Indexes Based on Years of Education			Final Indexes Allowing for Changes in Days of Education per Year of School Attended	
	Male Civilians (1)	Female Civilians (2)	Civilian Labor Force (3)	Civilian Labor Force (4)	Total Labor Force (5)
1950	94.8	96.5	95.1	92.9	93.1
1955	97.0	98.2	97.2	96.1	96.2
1960	100.0	100.0	100.0	100.0	100.0
1962	101.2	101.2	101.2	101.6	101.5

United States Estimates. Distributions of the United States labor force by highest school grade completed are available from labor force surveys for one month in each of the years 1948, 1952, 1957, 1959 and 1962. Quality indexes for these dates were computed and interpolated to obtain estimates as of the middle of the desired years. These are shown, for males, females, and all civilians, in the first 3 columns of Table 5.

These calculations, however, imply that a person who had attended school for any given number of years around the year 1900, and was still working in 1950, had an education equivalent to that of a person who attended school for the same number of years in the 1920's or 1950's. Taking the United States as a whole this assumption is not tenable, and an adjustment is required to allow for the fact that the amount of education represented by a year has increased over time.

From 1900 to 1956 the average number of days attended per pupil enrolled in public elementary and secondary schools increased from 99 to 158 per year, the increase being continuous until 1950. This came about in the following way. First, in the large city school systems there was no increase, but actually a small decline, in the average length of the school term.[1] Second, in the smaller cities and towns, in rural schools, and in the South, much shorter school terms were gradually brought close to the standards of big cities in the North, and in addition enrollment shifted toward the urban areas. In consequence the reported average length of the school term in the country as a whole (with schools in effect weighted by

---

1. The simple average for New York, Philadelphia, Chicago, Los Angeles and Washington was 188 days in 1900 and 182 in 1960.

enrollment) rose from 144 days in 1900 to 178 days in 1956.[1/] Third, the reported ratio of days of school attended to the product of enrollment and the average number of days in the school term rose from .686 percent in 1900 to .890 percent in 1956. These ratios suggest more absenteeism than actually exists because enrollment statistics exceed average class membership.[2/] Also, the rise in the ratio may overstate the decline in absenteeism if there was a reduction in the gap between enrollment and membership, but the presence of any such bias is uncertain. In any case, the bulk of the

---

1. The recent situation has been that almost all state laws require at least 180 days, the exceptions permitting 160 days in rural areas. Large urban school systems are still likely to go somewhat above 180 days and it is a bit surprising that the computed average is 178. The actual number may vary a little from year to year due to weather, epidemics, etc. For example, in Montgomery County, Md., the schedule is set on the assumption that schools will be closed a certain number of scheduled days because of snow. If the actual number of "snow days" falls short of the number anticipated, the school term will be longer than is expected, but if it exceeds the planned number the difference is made up by curtailing vacations. In some other jurisdictions this may not be required.

2. In 1957-58 average daily attendance equaled 92-1/2 percent of average membership, implying true absenteeism, as distinguished from dropouts, duplication of enrollment due to transferring among schools, and the like, was 7-1/2 percent. These data are not available for early years.

rise in this ratio clearly is genuine. It accounts for considerably more of the increase in days of school attended per year than does the extension of the school term outside the cities.

I base an allowance for these changes on the assumption that the same number of years of education represents the same amount of education throughout the period for persons attending school *regularly* in large city school systems, or in college. The individual who *regularly* attended for 8 years a rural school system operating (say) 90 days a year is considered to have had only the same education as one who for four years *regularly* attended a city school system operating 180 days. And a pupil who, in either school system, missed (say) half his scheduled classes (usually because he was working) is treated as having received only half as much education as a pupil who was present every day for the same number of years.

As individuals educated under conditions of the past are replaced in the labor force by those educated under more recent conditions, the same number of years of education comes to mean more education. I estimate that the increase in the average quality of the civilian labor force from 1950 to 1962, put at 6.4 percent (as implied by Table 5, Column 3) when only changes in years of schooling were considered, should be changed to 9.4 percent (Table 5, Column 4) to allow for this major development.[1]

---

[1] The reader is cautioned that translation of the treatment described in the text to the adjustment of the quality index required some statistical assumptions. These are detailed in *Derivation of Tables in Education Chapter*. As pointed out there, the allowance made for changes in the number of days in the school year is much smaller than that I used in *The Sources of Economic Growth in the United States and the Alternatives Before Us*.

European Estimates. When the present study was started information concerning the amount of education of the labor force was almost wholly lacking for Europe. The gap has now been partly filled, and a good deal of additional information is in prospect for the immediate future. Estimates of either the distribution of the labor force by level of education, or of the average number of years of education (from which changes in the quality index can be approximated with the aid of collateral information) are available for certain years, thanks to the research of several investigators. The present availability from other sources of estimates and projections of the education of the labor force is as follows:

Country	Years	Investigator
Belgium	1940, 1950, 1960, 1970	Raymaekers
Belgium	1950, 1960, 1970	Frank and associates at DULBEA
France	1936, 1946, 1954, 1955, 1961, 1965, 1970, 1975, 1981	Debeauvais and associates at the Institut d'Etude du Développement Economique et Social
Norway	1930, 1950, 1960, 1970	Arnesen
United Kingdom	1931, 1951, 1961, 1971	Knight

As the preliminary draft of this chapter is prepared almost all of these estimates remain preliminary and unpublished, partly because the investigators in most countries hope to incorporate still-unavailable results of the Census of Population for 1960 or 1961.[1]

---

[1] Most of them are scheduled for publication by OECD which, at the present writer's urging, undertook arrangements for their preparation.

The present study has attempted preliminary estimates for Italy, based on Census data for 1951 and ISTAT estimates for the upper end of the distribution in 1960-61, and for Denmark, based on sample data for 1961 from the Social Forksningsinstituttet. An estimate has also been attempted for the Netherlands in 1960, based on the Census. This estimate is described in the notes to this chapter but excluded from the tables pending further checking.

Estimates are not now available for Germany, but a Microcensus survey for April 1964 may make them possible when the tabulations become available.

Since a substantial amount of additional new information is anticipated before the present study is completed, the estimates now presented are highly tentative as well as incomplete. The tentative estimates are described in full in "Derivation of Tables in Education Chapter."

Table 6 provides two sets of quality adjustment indexes for each country. Part I presents indexes based on application of the education weights referring to each area; these are the indexes appropriate for the analysis of growth rates. Part II, which permits some further analysis, presents similar indexes computed by the uniform application of United States education weights to all areas.

Two general comments are in order. First, the computations usually were not based on data referring to the specific years shown; the indexes are interpolations between available years. This is not a serious limitation on the estimated change over the 1950-62 period as a whole, but does mean that the subdivision between the 1950-55 and 1955-62 periods has no claim to accuracy in the European estimates.

Table 6

Education Quality Indexes

(1950 = 100)

Area	Part I Each Area Based on its Own Weights				Part II Each Area Based on United States Weights			
	1950	1955	1960	1962	1950	1955	1960	1962
United States	100.0	103.3	107.4	109.0	100.0	103.3	107.4	109.0
Northwest Europe								
Belgium	100.0	104.0	108.0	110.0	100.0	103.0	106.0	107.5
Denmark	100.0	101.3	102.7	103.2	100.0	100.9	101.7	102.1
France	100.0	102.4	104.9	106.1	100.0	101.8	103.7	104.6
Germany								
Netherlands								
Norway	100.0	102.2	104.5	105.5	100.0	101.7	103.4	104.2
United Kingdom	100.0	101.9	104.0	105.0	100.0	101.2	102.5	103.1
Italy	100.0	103.7	107.6	109.3	100.0	101.9	103.7	104.6

The second general comment concerns changes in the number of days of school attended per school year in Europe. The only specific data available to me over a long period refer to France, and are based on a study by the Institut d'Etude du Développement Economique et Social.[1] The French school system is national and, as is usually true in Europe, the school year is uniform throughout the country. Since 1885 the length of the school year has been shortened by extending vacations; we have noted that a similar shortening occurred in large-city systems in the United States. Since 1900 there has been no decline in absenteeism, as indicated by a ratio of the number of pupils present to enrolled students that has been almost constant at around 90 percent. The reported ratios before that were 75 percent in 1851, 77 percent in 1876, and 78.6 percent in 1891.[2] Apparently France was nearly half a century ahead of the United States in reaching a stable ratio. According to this evidence, no upward adjustment of the movement of the quality adjustment index for the increase in the number of days attended per school year, such as was made for the United States, is needed for France. There was no increase in the length of the school year, and the decline in

---

1. Michel Debeauvais, Jacqueline Pillet, Pierre Maes, and Nicolas Panayotakis, L'Education de la Population Française et Son Evolution de 1850 à 1980, August 1963.

2. The authors of the Institut report believe the true rise was less than this because of numerous duplicate enrollments in the earlier data.

absenteeism ended too early to affect the labor force data for the period beginning with 1950.[1] If any adjustment at all were to be made in the movement of the quality indexes it would be downward, to take account of the shortening of the school term as vacations lengthened, but I agree with the French authors that it seems more sensible to ignore this change -- particularly since the number of school years required to attain particular certificates or degrees was not changed on this account.

In the absence of specific information for the other Continental countries I assume in this preliminary draft that the situation is similar to that in France, and introduce no adjustment for changes in the length of the school year or in absenteeism. The opinion expressed by nearly all informed persons I have queried is that there has been little or no increase in the number of days attended per year of school during this century. The writer confesses some skepticism concerning this evidence, in view of the large rural populations in most countries, the improvement of transportation, and the advances in medicine,[2] but it does seem that any downward bias over time on this account in the Northwest European indexes, absolutely and relatively to the United States index, is not gross. To add 0.1 points to the growth rate of the education quality indexes in Northwest European price weights (1.2 points

---

1. The French estimate for 1946 (which I averaged with a 1954 estimate to obtain 1950) apparently incorporates an adjustment, referring to the 1946 labor force who were educated before 1900, but it is so negligible that its effect on my 1950 estimate can be ignored.

2. As indicated in the detailed description of the French estimates there is even some indirect evidence that may run counter to the indication that there has been no decline in absenteeism in France itself.

to the 1962 index) the change would have to have been considerably more than one-fourth as great as in the United States. A change much greater than this seems unlikely.

John Vaizey, in 1962, estimated that over the past half-century in England "average attendance has risen by at least a sixth because of the decline in truancy and the improvement in child health."[1] Estimates of the time pattern of the decline would be needed to derive a specific estimate of the effect on the United Kingdom quality index.[2] Some adjustment for attendance is evidently needed but, in this preliminary version of the study, it has seemed better to omit it, and simply to recognize the probability that all the Northwestern European indexes may rise somewhat too little on this account.

In Italy school attendance is still irregular in some areas, especially but not only in the South, and actual school terms vary. I think we must assume that the average number of days attended per year has been rising. I have tried to make rough allowance for this in the distributions of the labor force by years of education rather than to attempt a specific adjustment for changes in days of education per year. Except at the bottom, my educational distributions for Italy were obtained by translating degrees or certificates into years of education. I have supposed that the same degree or certificate obtained at different times represented equivalent education, so that if more years were required to obtain it in the past than now, because of absenteeism, this is automatically allowed for. An adjustment at the bottom of the distribution involves the division between those with no education and those with 1-4 years of school.

---

[1] John Vaizey, *The Economics of Education*, The Free Press of Glencoe Inc., New York, 1962, p. 81.

[2] If we take Vaizey's estimate as a 17 percent increase, this compares with a 40 percent increase in days attended per year in American elementary and secondary schools over the same period. From 1950 to 1962 the "days" adjustment raised the quality of American labor by 2.7 percent. Applying the ratio of 17 to 40, we might estimate it raised the quality of British labor in United States weights by 1.1 percent. Applying to this the ratio of the British increase in Northwest European weights to the increase in United States weights (5.0 to 3.1) we would obtain an adjustment of 1.8 percent over a 12-year period. This calculation, obviously intended only to suggest the possible order of magnitude, would imply an adjustment to the growth rate of the quality adjustment index in Northwest European weights of .15.

Comparison of Educational Quality of the Labor Force Among Countries

If we make the assumption -- to be examined and modified later -- that individuals with the same number of years of education in the various countries have an equivalent education, the procedure used for time series can also be applied to obtain an international comparison of the quality of labor. For our purpose it is appropriate to use United States weights in this comparison. Indexes so computed are given in the first column of Table 7, with the United States level taken as 100.

The specific assumption underlying this column is that for persons receiving their education in very recent years the same number of years of education represents equivalent education. Put another way, it is that the same number of years of education in all European countries, and for regular attendants of American large-city schools, have represented equivalent education throughout the 20th century. For comparisons involving the United States this is quite different from an alternative assumption that for all

Table 7

Education Quality Indexes, 1960, Based on United States Weights

(United States = 100)

Area	Based on Years of Education	Based on Age of Leaving School	Average (Final Estimates)
	(1)	(2)	(3)
United States	100.0	100.0	100.0
Northwest Europe			
Belgium	93.9	90.3	92.1
Denmark	88.3	95.5	91.9
France	92.5	91.9	92.2
Germany			
Netherlands			
Norway	90.7	97.9	94.3
United Kingdom	98.0	92.0	95.0
Italy	79.8	82.2	81.0

persons in the labor force the same number of years of education represents equivalent education. Its importance may be indicated by describing the calculation of the index for France given in Column 1 of Table 7.

When the United States education weights are applied to distributions of the labor force in 1960, and the quality of those with 8 years of education is taken as 100, computed quality indexes for the civilian labor force (weighted averages of indexes for males and females) of 118.9 for the United States and 103.6 for France are obtained. But the adjustment made for changes in days per school year in the United States implies that the quality of labor in the United States in 1960 was only 94.5 percent of what it would have been if all age groups had attended school for as many days per year as recent students. For comparison with other countries, the United States index is therefore multiplied by 94.5 percent, which reduces the United States index to 112.4. Thus it is calculated that the average educational quality of the French civilian labor force is 103.6 ÷ 112.4 or 92.2 percent of the American quality. Setting the quality of the armed forces as equal in the two countries for familiar reasons, the percentage for the entire labor force becomes 92.5, the figure given in Column 1 of Table 7. All the European indexes are about 5 percent higher than they would be if the "days adjustment" had not been made in the United States. They are too high insofar as some similar (though smaller) adjustment should have been made in Europe.

The comparison given in the first column of Table 7 is not my final estimate of the comparative educational quality of the labor forces. A further adjustment, described below, will be introduced.

Alternatives to Use of the School Year. All the quality adjustment indexes computed so far assume that individuals obtaining the same number of years of full-time education in different countries at the present time receive, on the average, equivalent educations. The same assumption was made in the comparison of different dates in one country, except for the special adjustments for days of education introduced explicitly for the United States and implicitly for Italy.

It is instructive to consider limitations of this procedure, and some possible alternatives and modifications. Most of these alternatives would hardly affect time-series within a particular country, but some would affect the comparison of countries. One (the second considered) leads me to modify the international comparison based on years of education.

1. Without departing from the use of time spent in school, we might have used total hours or total days rather than total years as a common denominator to compare countries. Estimates for the current school population given in Table 8 permit the effects of using these alternatives to be evaluated. To attempt direct estimates of hours or days spent in school by the labor force would be impossible, and even the comparisons attempted for recent students are extraordinarily difficult, but the results should portray the general situation.

Columns 1 to 3 show, respectively, the average number of scheduled days per year, hours per day, and hours per year spent in classes. Only the last of these, hours per year, provides a reasonably valid comparison. The first two columns, taken separately, are almost meaningless because of differences in schedules. American schools operate five days, of equal length, a week. European schools operate, variously, 5 full days, 6 full days, 4 full days and 2 half days (perhaps the most common arrangement), 5 full days and 1 half day, or 3 full days and 3 half-days. Although Column 1 counts half-days as one-half, this goes only part way toward obtaining comparability; German

Table 8

Time Spent in School by Recent Students, and Possible Alternative Adjustments to 1960 Education Quality Indexes

Area	Time per Year of Schooling			Time Spent in School During School Career					Possible Adjustment (in Points) to Education Quality Adjustment Indexes, Based on Hours per Year
				Number			Indexes: United States = 100		
	No. of Scheduled Days per Year 1/	No. of Scheduled Hours per Day 1/	No. of Scheduled Hours per Year	Years	Scheduled Hours	U.S. Equivalent Years Based on Annual Hours 2/	Years	Scheduled Hours	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
United States	180	5.69	1,024	12.90	13,210	12.90	100	100	-
Northwest Europe	200	5.32	1,069	10.26	10,968	10.71	80	83	2.7
Belgium	198	3/ 5.39	1,071	11.39	12,199	11.91	88	92	3.1
Denmark	212	5.08	1,079	8.84	9,539	9.32	69	72	2.9
France	184	5.54	1,019	10.74	10,944	10.69	83	83	- .3
Germany	229	4.83	1,110	9.13	10,134	9.90	71	77	4.6
Netherlands	202	5.41	1,092	10.43	11,390	11.12	81	86	4.1
Norway	193 4/	5.62	1,086	9.99	10,849	10.59	77	82	3.6
United Kingdom	189	5.64 5/	1,069	10.96	11,716	11.44	85	89	2.9
Italy	202	4.47	902	8.86	7,992	7.80	69	60	- 6.4

1. Part-days are counted as one-half.
2. Calculated by multiplying the United States figure from Column 4 by Column 8 (before rounding).
3. Assumed to be the same as in the Netherlands in each age group.
4. Assumed to be the same as in Sweden in each school grade.
5. Assumed to be the same as in the United States in each school grade.

Note: For a description of the estimates see text and "Note to Table 8" in the "Notes to Education" section.

and Italian elementary schools, for example, operate 6 days of equal length, but the children do not return after lunch and the schedule (9 a.m. to 1.10 p.m. in Italy) approximates half days in some other countries. However, in Column 1 all 6 days are counted as full days.

The division of weekly hours among the days of the week in Europe is a matter of convenience and is not considered to affect the quality or content of education. Similar schools in the same system often operate with the same weekly hours but different daily schedules, and changeovers are made from one schedule to another (recently, for example, in parts of Holland from 4 full and 2 half days to 5 full days) without change in curriculum.

The number of scheduled hours per year, given in Column 3, gets around this particular difficulty. Although it is equal to the product of Columns 1 and 2, it is better thought of as the product of weekly hours and number of school weeks, reduced on a proportional basis to allow for holidays. Except for Italy, yearly school hours are rather similar among all the countries. The shortest hours, in France, are only 8 percent below the longest, in Germany. Annual hours in the United States are 4 percent below the Northwest European average, mainly because the longer American summer vacation is not wholly offset by the longer vacations at other times and more numerous holidays that prevail in Europe. In comparison with most Northwest Europeans, American students attend school more hours per day but fewer days a year.

Columns 4 to 8 compare the total time spent in school by American and European students, as of 1957-58. Northwest European children were, on the average, receiving 80 percent as many years of education, and spending 83 percent as many hours in school, as American students. There is substantial variation among the Northwest European countries, and it is about equally large whether years or hours are used (although the order is not the same).

It is possible to approximate the changes in the international quality indexes for the labor force, given in the first column of Table 7, that would result from considering the same number of hours of school attendance as equivalent education at the present time rather than the same number of years. This assumption would raise the United States-equivalent number of years of education of the labor force in the various countries by the difference between Columns 4 and 6 in Table 8. Given the pattern of Northwest European educational distributions, a difference of one year in the average education of the labor force would change the quality index based on United States weights (United States = 100), by something like 6 index points. As indicated in Column 9 of Table 8, the alternative assumption would therefore raise the quality index for Northwest Europe, as given in Table 7, by about 2.7 index points. All the Northwest European indexes based on years of education except that for France would be raised 3 to 5 points relative to the United States and France.[1]

Although it is impossible to be sure, I doubt this change would be an improvement. Modest differences in class time are unlikely to measure anything relevant to the quality or intensity of education. The various school systems presumably try to adapt their annual schedules of class work and home work, together, to take best advantage of the absorptive capacities of the children they teach. Differences in the institutional environment, including the workweek and vacation habits of adults, and differences in climatic conditions must affect the pattern selected. My preference for the assumption that a year of education is equivalent in all countries is reinforced by the inherent difficulties of the statistical comparisons attempted in Table 8, as well as by the absurdity of downgrading the highly regarded French schools on the basis of such calculations.

---

[1] The effect on my "final indexes," which are described in the following section, would be only half this large.

These comments are less appropriate in the case of Italy. Annual hours are much shorter than elsewhere. They are 12 percent below the United States and 16 percent below the Northwest European average according to Table 8, and, even so, may well have been overestimated. It is doubtful, moreover, that Italians would justify short hours entirely on the grounds that an educational loss is not entailed. Rather, it appears that resources available for education are a limiting factor (Italy has been straining to provide facilities to meet her obligations under the compulsory education laws), and that the multiplicity of national and religious holidays is a contributing influence. A case could be made for reducing the Italian labor force quality index by about 6 points, as calculated in Column 9, or at least by some substantial fraction of this amount.

2. Professor Malinvaud has urged a second alternative. Malinvaud would agree -- indeed insist more strongly than I -- that differences in the length of the school year should be ignored in the calculation of quality indexes. However, he believes the age at which full-time education ceases provides a better indication of educational achievement than the number of school years. Thus he would consider labor force members who left school at, say, 15 years of age to have an equivalent education regardless of whether they started school at age 5, 6, or 7, and hence had had 10, 9, or 8 years of education.

I believe this view would receive support from American educators. They consider that only the exceptional child is capable of successful first grade work at age 5, and that considerable numbers, particularly among boys, still lack sufficient maturity to make it worthwhile to enter first grade at age 6. Most would argue that to reduce the normal age for starting first grade from 6 to 5 would add little or nothing to educational achievement at a later age, and might entail a net loss as a consequence of frustration and discouragement unless the content of the course was radically downgraded.[1] Raising the age to 7, it seems to be implied, would not involve a loss nearly equivalent to a whole year's work, since progress in reading and other elementary subjects would be more rapid.

On the other hand, English children have started school at age 5 for generations without creating any general belief that this is wasteful or any general move based on these grounds to raise the age.[2] This is the more impressive since implementation of a desired increase to 16 in the compulsory school-leaving age is delayed by lack of educational resources. The numerous British commissions have not suggested that a substantial net gain could be achieved without lengthening compulsory education by raising the age at which it is received. Against this, Svenillson and associates, in discussing all the OECD countries, state that "reforms to extend /compulsory education/ below

---

1. An exception might be made for children from culturally deprived homes who, by age six, are already at a distinct disadvantage. However, the recommended prescription is not to enter first grade earlier but to increase kindergarten and nursery school training. The text sentence assumes the amount of kindergarten and other pre-first-grade training to be unchanged.

2. Raising the compulsory age has been suggested not on these grounds but to meet a teacher shortage anticipated to arise by 1971 in consequence of a sudden rise in births. According to the Economist (September 12, 1964) this would have little effect on enrollment of 5-year-olds unless the permissible age were also raised, which is considered unthinkable.

the present entrance age do not seem to be envisaged, not even in countries where school starts at as late an age as seven."[1]

The school-starting age is ordinarily said to be 5 in the United Kingdom, 6 in the United States, Belgium, France, Germany, Italy, and the Netherlands, and 7 in Denmark and Norway. However, these numbers have different meanings. Also, the age at which a child may be admitted to school and the age at which he must attend school often differ. Thus in the Netherlands, for example, a child cannot start school until the September following his sixth birthday, whereas in Belgium he can start in the public schools at 5-1/2 and in the private schools, with roughly half the enrollment, he may often start even earlier. The average starting age can easily vary as much as one-half year in either direction from the nominal age. Calculated estimates of the starting age are given in the first column of Table 9. These were computed from enrollment ratios by a uniform but approximate statistical procedure.[2] The results, for the most part, appear generally consistent with

---

[1] Organisation for Economic Co-operation and Development, Targets for Education in Europe in 1970, Ingvar Svenillson in association with Fredrich Edding and Lionel Elvin (Paris, 1962), p. 84.

[2] The 1957 or 1958 ratio of enrollment to population in the ten-year age span 5 to 14 was obtained from OECD, Svenillson and associates, op. cit., p. 108. The average starting age given in Column 1 equals 15 years minus ten times this ratio. The estimates will be a trifle high to the extent older children within the age bracket are not in school. They are subject to slight variation from unbalanced age distributions, and rather more from the time of year to which they refer, as well as from errors in the data. The source is the same as was used to compute average years of school, reproduced in Column 3 from Table 8.

Table 9

Calculation of Average Actual Age of Leaving School, and Effect of Basing International Quality Adjustment Indexes (U.S. = 100) on Age of Leaving School Instead of Years of Education

Area	Recent Students					Labor Force	
	Computed Average Starting Age (Years)	Adjusted Average Starting Age (Years)	Average Years of Education (Years)	Implied Average Age of Leaving School (2+3) (Years)	Difference from United States in Starting Age (Years)	Estimated Adjustment in Quality Index (Points)	Adjusted Quality Index 1960 (U.S. = 100)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
United States	6.0	6.1	12.9	19.0	--	--	100.0
Northwest Europe	6.1	5.9	10.3	16.2	- .2	- 1.2	
Belgium	5.5	5.5	11.4	16.9	- .6	- 3.6	90.3
Denmark	7.4	7.3	8.8	16.1	1.2	7.2	95.5
France	6.0	6.0	10.7	16.7	- .1	- .6	91.9
Germany	7.0	6.4	9.1	15.5	.3	1.8	
Netherlands	6.4	6.4	10.4	16.8	.3	1.8	
Norway	7.3	7.3	10.0	17.3	1.2	7.2	97.9
United Kingdom	5.1	5.1	11.0	16.1	- 1.0	- 6.0	92.0
Italy	7.1	6.5	8.9	15.4	.4	2.4	82.2

school laws and practice but in some cases the calculated numbers appear to be outside the likely range suggested by other information and modifications appear appropriate; the major adjustments are for Germany and Italy. The modified estimates, given in Column 2, provide a more accurate picture of differences than the nominal age, but the estimates for some countries may be off a few tenths of a year relative to others.

The sum of the average age of starting school and the average years of education gives the approximate average (arithmetic mean) age at leaving school. This is given, for recent students, in Column 4. In comparison with the variation among Northwest European countries in the length of education, the average age at leaving school as of 1957-58 appears more uniform. The order of countries is also different: the United Kingdom has the longest average span of education but among the youngest average school-leaving ages.

Differences among countries in the average age of entering school must have been about the same when the labor force was being educated as in recent years. The age of leaving school is the entering age plus the number of years of education (unless education is interrupted).[1] We can therefore approximate the change that would be made in the quality adjustment indexes based on years of education if we were to substitute the Malinvaud proposal to base comparisons on age of leaving school. The difference between the average school-beginning age in each European country and the United States is simply multiplied by six. This relies on the rule of thumb that, in Europe, a difference of one year in average years of education is equivalent to about six points in the quality adjustment index (United States = 100) in United States weights. The last 2 columns of Table 9 show the changes that would be introduced in the quality adjustment indexes given in the first column of Table 7 and the indexes so adjusted. Shifting from school years to school-leaving age would sharply raise the Scandinavian indexes and sharply lower the British index. It would eliminate the difference between the French and British indexes. However, it would only slightly affect the comparison of the United States and Northwest Europe as a whole.[1]

---

[1] Wars interrupted education to a greater or lesser extent in all countries covered, either by causing the temporary disruption and closing of schools or by delaying the education of servicemen. The procedure followed here treats the individuals affected as if they had obtained their education at the usual age. Interruption of education for other reasons should not seriously distort compariso countries or dates.

I find Malinvaud's suggestion persuasive but believe its full acceptance would go too far. I adopt the compromise of averaging the results of basing international comparisons on years of school and on school-leaving age. This assumes that half the disadvantage of a later start is made up by the time of leaving school. The averages, which represent my final estimates of education quality indexes among countries, are given in Column 3 of Table 7.

No significant adjustment of the time series for individual countries is implied by this decision because important changes in the age of starting school seem not to have occurred.[2]

3. With minor exceptions, the education data that have been used cover all types of full-time education, except kindergarten, whether obtained in public schools or in church-affiliated or other private schools.

---

[1] It should be noted that no close relationship exists or should be expected between the school-leaving age of recent students, given in Column 4 of Table 9, and quality indexes for the labor forces based on school-leaving age, given in Column 7.

[2] By changing the weights attached to different education groups in a country, as estimated here, the shift from years of school to age at leaving school could change the time series indexes, but only slightly.

Types of education or schooling that are excluded will now be examined briefly.

(a) Kindergarten and nursery school years are omitted, even when provided in regular elementary schools. This type of training is thought to facilitate learning in subsequent years.

In 1962 the number enrolled in kindergarten in the United States equaled 56 percent of the number of 5-year-olds. The proportion had risen sharply since World War II. From 1920 to 1940 it seems to have been increasing only slowly, with the proportion somewhere around one-fourth. Since persons 18 years old in 1962 would have been 5 in 1949, the recent great expansion in kindergarten attendance can have had but little effect on the labor force by 1962, and it is unlikely that as many as one-fourth of 1962 labor force members can have attended kindergarten. The proportion could hardly have risen more than 5 percentage points from 1950 to 1962, which would have meant an increase over a 12-year period of .05 years in average time spent in kindergarten by labor force members. Even if this were counted as equivalent to a similar increase in regular school years -- which would be far too much -- it would have only a small effect on the United States education quality index.

Kindergarten is less common, and its extension to large numbers more recent, in Europe. The effect on European quality indexes would probably be even less than in America. Any allowance for kindergarten would lower the level of quality indexes in most if not all European countries relative to the United States, but not by much.[1]

(b) In all countries there is and long has been considerable home study, participation in evening extension courses, and other forms of adult education on the part of members of the labor force. This defies measurement

---

1. It may be noted, however, that in the Netherlands children 3 to 6 years of age spent an average of 1.3 years in 1940, and 1.8 years in 1961, in Kleuter-onderivijis, which is translated as "nursery schools" in Dutch sources.

on any comparable basis, but its omission is unlikely to impair seriously our international or intertemporal comparisons of the quality of labor.

(c) Courses in proprietary commercial and trade schools, offered on a fee basis, are omitted even if study is full time during the day (though often for only a matter of months). Also omitted are correspondence courses and courses taken in the armed forces.[1]

In the United States, regular schools and colleges employ over 100 times as many persons as proprietary commercial, trade and correspondence schools, which gives some idea of the relative resources going into such schools. On the other hand, a large proportion of the labor force has had some formal education, usually of short duration, in these forms. For example, a 1954 survey showed that among a sample of 1028 males who graduated from high school in the thirties but did not attend college, 55 percent had attended trade, technical or business schools after high school, an additional 8 percent had received some training in the armed forces or company schools, and 37 percent had no education beyond high school. Average earnings of the first group were around 4 percent above those of the other two groups combined,

---

1. However, individuals obtaining in these ways academic certificates or diplomas, such as a high school diploma, that are ordinarily obtained by full-time study will usually be credited in the data with the same number of years of education as persons obtaining the certificate in the usual way. Where data are derived entirely from the age at leaving school this is not the case.

after standardization for rank in high school class.[1]

Data are not available to allow in the quality adjustment indexes for these types of education but, if the earnings differential typically is not much over 4 percent, differences between 1950 and 1962 in the amount of such education held by the labor force could hardly have been great enough to have affected the United States quality index appreciably.[2] I believe this also to be true of the European indexes, and probably of intercountry comparisons; in a comparison of the United States and Europe these types of education probably offset the greater use of released time in Europe, to which I turn next.

(d) Many young European workers attend school, usually one day a week, on released time. Most of them are enrolled in what is intended to be a coordinated work-study program for learning an occupation, and usually receive a certificate, upon examination, if the program is completed. Young people in Germany and Denmark, and certain groups elsewhere, are legally required to attend part-time day classes after leaving full-time schools, whether they are employed or not, until they reach age 18.

Countries have different systems of on-the-job training, varying greatly in their formality and degree of government supervision. In America reliance is overwhelmingly on informal on-the-job training and experience. Most workers become qualified in this way even in those few occupations for which registered apprenticeship programs exist.[1] In most occupations qualification is judged mainly by ability to do the work required after a brief learning period. In Europe government-supervised programs and certificates play a much greater role both in training and in obtaining a job. This extends in some countries to nearly all occupations. To measure the efficacy of on-the-job training in different countries or at different dates appears impossible and I make no effort to do so in this study.

---

[1] See data from the Wolfle-Smith Survey summarized in my Proportion of Income Differentials among Education Groups, op. cit.

[2] My procedure automatically includes the effects of increases in this type of training that are associated with an increase in general education. Thus, if high school graduates are more likely than elementary school graduates to receive such training, the increase in the total amount of such training that results from an increasing proportion of high school graduates will be automatically reflected in my quality indexes.

Time spent in day schools on a part-time basis, whether as part of a work-study program or not, could, however, be converted to full-time equivalence and counted in our education measures if sufficient data were available.

Data accurate enough to warrant such an adjustment are not available, but it is possible to judge the orders of magnitude involved, and they are small. From information summarized in the statistical notes to this chapter, it seems clear that inclusion of part-time day education on a full-time equivalent basis could have only a small effect upon our labor quality indexes.[2] Inclusion of such education could hardly change a comparison of

---

1. Replacement needs for skilled workers in trades having apprentices are estimated (by the National Manpower Council) to be met as follows: Proportion not receiving formal training 58-64 percent; registered apprentices completing training 12-16 percent; registered apprentices leaving without completing training 6-8 percent; apprentices, not registered 14 percent; vocational school gradautes 4/10 percent; immigrants trained abroad 4 percent. Source: James R. Wason, op. cit.

2. See Part III of Derivation of Tables in Education Chapter.

average years of education of the labor force between any two countries covered by more than 0.2 years, or more likely 0.1, or the international quality indexes (United States = 100) by more than one point. It is unlikely that in any country it would raise the increase in average years of schooling from 1950 to 1962 by more than 0.1 years, or the quality index for any country by as much as one point. Most comparisons would scarcely be affected.

4. Measures of education used in this study are unavoidably in quantitative terms. Certain assumptions and implications of this procedure must be specified.

(a) No distinction has been made with respect to subject matter. The procedure followed implies that, on the average, the education that had been received by members of the labor force in a country was as relevant to participation in economic life at one date as at another. The international comparison makes the same assumption between countries.

The assumption is not, it must be stressed, that all subjects or curricula have equal economic value. It is that differences between times and countries in subjects studied are not correlated with differences in economic value, a much less restrictive assumption.

To test this assumption is not possible. It would require (1) that distributions of the labor force at different times and places by years of school be further divided by type of education throughout the years spent in school; and (2) the availability of corresponding data on earnings, adjusted for differences in natural ability and other correlated factors, for individual with each type of educational background. Comprehensive information of this type is not available for any country. The writer has no preconception as to the relative economic value of different types of education (except for a great distrust of judgments often expressed) and, consequently, no guess as to the direction of any biases that may be involved.[1]

(b) The comparisons ignore differences in educational requirements imposed by differences among nations. They thus assume that differences in the difficulties of the native language are insufficient to affect greatly the time required to learn to read and write, which is basic to most school subjects. This would be quite unacceptable in a comparison of France and China, or of Turkey before and after 1924. Differences among the languages relevant to the present study do not appear drastic, but it is true that the English language requires much more attention to spelling than the Continental languages, in which spelling and pronunciation usually coincide. The complexity, relative to the metric system, of Anglo-Saxon weights and measures (or the British currency) may also be noted.

Against this, and probably more important, may be set the size and contiguity of the Continental countries which has forced them, and especially the smaller countries, to devote much of the time of all students to learning a second and third modern language. English itself is widely taught, and increasingly so. The more limited attention the United States has devoted to foreign languages handicaps few Americans in their economic life.

---

[1] It should be recognized, of course, that the relative value of different types of study varies from time to time and place to place. One aspect of this deserves special mention. The great subdivision of work in American industry is often regarded as an important reason for high American productivity. It has the effect of reducing the need for craftsmen with comprehensive skills while increasing the need for flexibility and adaptability to change. It seems likely that the extensive and rapidly growing vocational training programs in Europe may be appropriate so long as continuation of European production practices is presupposed, but that they would not be appropriate in America, and that in Europe they may discourage reorganization of production along American lines.

(c) Comparisons based on years of education assume equivalence, in some difficult-to-define sense, of the quality of a year's education. Individuals in the labor force with the same number of years of education, obtained at the same age, are considered to have received an equivalent education no matter when, or in what country, it was received (aside from the "days" adjustment, where made). Even to discuss similarities and differences among countries would require extended space and be wholly inconclusive.[1/] Adequate comparisons of achievement are simply not available.[2/]

---

1. An interesting short discussion of some of the difficulties of comparison (but itself, I think, not wholly free of errors) is contained in Walter V. Kaulfers, "Pitfalls in Comparing Foreign Schools with Ours," The Educational Record, July 1963, pp. 275-281.

2. Often enough to require comment, the frequent admission to American colleges, with third-year standing, of European-trained students who are ready to enter European universities is adduced as "evidence" that American schools achieve in 14 years what European schools achieve in 12. If the comparison were valid at all, it would suggest equivalence of 14 years of American education with 13 in Europe. The European student usually has had not 12 years of preparation but 13, and is typically at least one year older than the American college entrant. In addition, much of the advanced credit granted is for knowledge of the language of the country in which he was trained.

But this comparison has almost no pertinence for the comparisons made here. The main point is that a very small percentage of the European labor

Over time, it is likely that the quality of education in the United States has improved; at least, all objective measures of inputs into the educational system (such as teachers' qualifications, class size, school facilities, or expenditures per pupil) have shown marked improvement. Quality in Europe presumably has also improved; at least the same type of input measures show this to be the case. There is, therefore, some presumption that the quality indexes are biased downward over time.

---

force ever attained an education sufficient to qualify for university admission. This group typically had attended different schools from the mass of students, sometimes from as early as age 12, and its education was not representative of the mass of students. Often entrance to such schools required excelling in examinations. The group who attained the qualifications for admission to universities was small and select.

The assumption of the international quality index computations is not that individuals with the same amount of education represent the same quality of labor. If it were, United States earnings differentials would not have been reduced by two-fifths for use as weights in the computation of earnings differentials, and the American edge in the international quality indexes would be much larger than has been computed here. The assumption is rather that individuals of the same natural ability with the same amount of education represent the same quality of labor. To have any relevance, even for comparison of the small numbers who reach this level, the achievement of Europeans qualified to enter university would have to be compared with a similarly small and select group of American students with the same length of education and age; for most comparisons this level appears to be entrance into the second year of college, and at least age 19.

It is, of course, the net impact of education upon participation in economic life, rather than the validity of each of these assumptions separately, that is relevant to our comparisons. Thus it could be true, as Graham Hutton asserts, that the average intellectual standards (as the term is understood by Europeans) of American public education at all ages are lower, but education serves economic purposes better, in the United States than in Europe except Scandinavia and Switzerland.[1]

Conclusions from the Data

Both the possibility of errors in the statistics used to compute the quality indexes, and the uncertainties suggested by the discussion just concluded, indicate the need for caution in drawing conclusions from the education quality indexes. In doing so, I shall indicate the extent to which they would be modified by plausible changes in procedure. The qualifications apply more strongly to comparisons of the level of educational quality of the labor force in different countries than to the time series.

[The discussion that follows assumes that the final and complete estimates to be derived are very similar to the preliminary estimates given for some countries in this draft -- that is to say, it is written for the most part as if the estimates given here were final and complete. Conclusions based on the preliminary estimates actually used here would be more strongly qualified.]

The following conclusions appear to me warranted. I deal first with changes over time, and then with levels in 1960.

---

[1] Graham Hutton, We Too Can Prosper, George Allen and Unwin Ltd., London, 1953, p. 44.

Changes from 1950 to 1962

1. The education of the labor force increased from 1950 to 1962 in all the countries examined. This will be shown by any possible weighting scheme, including a simple count of the average years of education of the labor force (Table 10).

2. The amount of education of the labor force increased more in the United States than it did in Europe. The exact comparison depends on the weights assigned to different levels of education, but any sensible weighting scheme, uniformly applied in all countries, would yield this conclusion.

Series based on use of United States weights were given in Part II of Table 6. By this measure the education of the labor force increased about twice as much in the United States as in France, Norway, or Italy, almost three times as much as in the United Kingdom, and four times as much as in Denmark. The increase in Belgium came much closer to, but was still below, that in the United States. Even if (quite unjustifiably) no allowance had been made for the great increase in the number of school days represented by a year of education in the United States, the American index would have risen appreciably more than those for France, the United Kingdom, Denmark, Norway, and Italy, though not Belgium. (Compare Tables 5 and 6.) If a fraction other than 3/5 had been applied to United States earnings differentials to obtain earnings weights the relative position of the American and European indexes would be unchanged.

The United States would also show the largest increase if European rather than American weights were uniformly applied. The upward shift in the American educational distribution has, in fact, been so general throughout the distribution that no reasonable set of weights, uniformly applied, could

Table 10

Mean Years of Education of the Labor Force, by Sex, 1950 and 1962

(In Years)

	Males			Females		
	1950	1962	Increase	1950	1962	Increase
United States:						
Adjusted to recent content of days per year	7.59	9.25	1.66	7.87	9.62	1.75
Not adjusted	9.68	10.68	1.00	10.01	11.08	1.07
Northwest Europe						
Belgium	7.98	8.93	.95	7.95	8.81	.86
Denmark	7.46	7.82	.36	7.55	7.83	.28
France	8.09	8.65	.56	7.89	8.51	.62
Germany						
Netherlands						
Norway	7.90	8.40	.50	7.70	8.28	.58
United Kingdom	9.13	9.70	.57	9.42	9.88	.46
Italy	4.23	5.10	.87	3.89	4.88	.99

produce a different result.

An alternative measure of educational stock sometimes used is the average number of years of education of the labor force. This counts all years of education from first grade up as of equal value -- an unsatisfactory though simple procedure. Table 10 provides estimates for 1950 and 1962. When the education received in the past in the United States is reduced to equivalence with recent education on the basis of days attended per year, the 1950-62 increase in the average education of male members of the labor force increased by 1-2/3 years; even without this necessary adjustment it is a full year. The increases in France, Norway, and the United Kingdom were only about 0.5 to 0.6 years, about one-third the adjusted American figure, and that in Denmark still less. Those in Belgium and Italy were around 0.9 years. As with the weighted indexes, the difference between the United States and the major Northwest European countries is large.

The finding, which I consider unambiguous and firmly based, that the education of the labor force has increased less, not more, in Europe than in the United States is a major one. Increased education is a principal source of growth, and it is important to know that European countries have not been achieving more rapid growth by raising the education of the labor force more rapidly. This finding does not, in itself, tell us whether or not increased education of the labor force has contributed more to European than to American growth rates. It does tell us that if education has contributed more in Europe, this can only be because European conditions are different, not because Europe has succeeded in obtaining a greater increase in education of the labor force.[1]

3. In general, an equivalent increase in education raises the average quality of labor more in Europe than in America, and contributes more to the growth rate.

The same addition to the number of individuals with a given amount of education that is appreciably above the average amount clearly will raise the average quality of labor by a greater percentage in Europe. Suppose, for example, that we start with the situation in 1960 and increase the civilian labor force by one percent, the addition consisting entirely of persons who have 16 or more years of education (but who are distributed by sex, age, and natural ability like the present labor force). My procedures and estimates imply that this will raise the average quality of civilian labor by 0.60 percent in the United States, 1.62 percent in France (taken as typical of Northwest Europe) and 2.53 percent in Italy -- that is, by 2.7 times as much in France as in America and 4.2 times as much in Italy. If the one percent addition to the labor force were at the 12-year level, rather than 16, the contrast would be even more striking. The average quality of labor would be raised by 0.10 percent in the United States, 0.30 percent in France, and 0.75 percent in Italy -- that is, in the ratio of 3 (France) or 7-1/2 (Italy) to 1.[1] The greater increases in Europe reflect not only the lower average level of education but also the shape of the distribution. Persons with 12 or 16 years of education are scarce, and command a much larger earnings differential (after allowing for natural ability and other associated variables) over persons with 6, 8, or 10 years of education than they do in America. These calculations reflect the differentials given in Table 3, which are anything but exact. But if I am correct in guessing that they are more likely to understate than to overstate the difference between European and American earnings differentials, the contrasts between countries calculated in this paragraph are also more likely to be under than overstated.

---

[1] It must be pointed out that the increase that occurred in the education of the labor force from 1950 to 1962 (and the contribution of this increase to growth) depends very little upon changes in the education of the young that took place during this period, and no international comparison of these changes has been made or is implied. What affects our figures is the difference between the education of those who entered and those who left the labor force from 1950 to 1962 and this depends upon changes in the education of the young that took place over more than half a century.

Most of the increase in European educational levels, however, has not taken the form of increasing the percentages at the upper levels. Past increases in the compulsory school-leaving age raised, one year at a time, the number of years of education received by the mass of the population. In many cases the labor force includes persons educated when the school-leaving age was at 3 different levels. As younger age groups replace older ones in the labor force, the average educational level gradually advances. An increase in average years of education obtained in this way -- by raising the level at which the bulk of the population is concentrated -- has, properly, less effect on the quality indexes than one of equal size obtained by raising the proportions in the scarce higher educational levels.

---

[1] To check these calculations the reader needs the levels of the civilian quality indexes. These are 112.4 for the United States, 113.7 for France, and 84.3 for Italy when the quality of individuals with 8 years of education is taken as 100 and each country's own weights are used. (A comparison of these levels is, of course, meaningless.) Weights for persons with 16 years of education, given in Table 3, are 181 in the United States and 300 in France and Italy; with 12 years, 124 in the United States and 148 in France and Italy.

Although past increases in the compulsory school-leaving age were a main cause of the rise in the average level of education of the labor force in all the European countries except Denmark and Norway, there are important differences among countries in the extent to which this is so. As already noted, the United Kingdom has in the past done little to encourage or even permit an increase in the number of students who extend their education much beyond the compulsory level, and even today the bulk of students do not do so. In France the proportion has been rising for many years, and today it is no longer true that the legal school-leaving age is the decisive determinant of the time most students leave school. One consequence is that a given increase in the average number of years of education is associated with a larger increase in the quality index for the labor force in France than in England. This will be increasingly true for some time even if provision for future students in Britain were to be altered drastically. It is a correct reflection of what I believe to be a fact, that expansion of the numbers of persons with higher education and, especially, advanced secondary education, can do more for the European economies than a feasible rise in the general school-leaving age.

The United States has not had a heavy concentration of the labor force in any one narrow range, and changes take the form of a general rise in the distribution as a whole, with percentages at all upper levels rising, at all lower levels falling, and a gradual advance of the breaking point.

In practice, from 1950 to 1962 a given increase in average years of education of the labor force raised the quality index in the Northwest European countries by not more than twice as much as in the United States.

4. It is likely though not certain that the increase in education raised the quality of labor more in the United States than in Northwest Europe from 1950 to 1962, and contributed more to the American growth rate.

Estimates appropriate for this comparison are given in Part I of Table 6. I estimate that in the United States the increase in education raised the average quality of labor by 9.0 percent, or at an average annual rate of over 0.7 percent. The comparable estimates for France and the United Kingdom are 6.1 percent and 5.0 percent, yielding annual rates of 0.5 and 0.4. I have not yet estimated Germany, the third large country of Northwest Europe, but would be surprised if the increase were as great as that in France. The estimate for Norway falls between those for France and the United Kingdom, and that for Denmark is much lower. Only the Belgian figure is higher, and it exceeds that for the United States. It is not likely that inclusion of estimates for the missing Northwest European countries could yield an increase in the weighted average for the area as a whole of more than 6 percent, or 0.5 percent per year, which would be two-thirds of the United States increase.

With the labor share around 80 percent of the national income, these figures imply that increases in the quality of the labor force related to additional education contributed about 0.6 points to the growth rate of real national income per person employed in the United States and 0.4 points in Northwest Europe.1/

---

1. This is, of course, without allowance for economies of scale. Estimates of this type given in this chapter are crude. More precise computations will be given in a subsequent chapter.

If the differentials in the European education weights are too small, which is not unlikely, the Northwest European figures should be raised. They should also be raised if there was really a significant reduction in school absenteeism. Thus the gap between the United States and Europe could well be overstated. It is possible, though not likely, that more adequate data would eliminate, or conceivably even reverse, the differential.[1]

Among the Northwest European countries the indexes computed for France, Norway and the United Kingdom are rather close to one another. The Danish series increases less. The Belgian series, which rises more, derives ultimately from rather inadequate data for enrollment in the past; a check upon its accuracy can be obtained when Census material becomes available.

The Italian series rises a trifle more than that for the United States and much more than any of the others except that for Belgium. This is mainly because we have supposed much larger education differentials to be appropriate in Italy below the 8-year level.

International Comparisons of the Educational Quality of the Labor Force

1. The educational quality of the labor force in Northwest Europe may fairly safely be put below that in the United States.

---

[1] It will be noted that the quality adjustment indexes for France and the United Kingdom rise 1.5 and 1.9 points more, respectively, from 1950 to 1962 when Northwest European weights are used than when United States weights are used. To pick up, say, another point would require a large, but not impossible, further widening of the education differentials. I indicated above that an adjustment much over 1.2 points for improved attendance seems improbable.

Almost any quantitative appraisal of the data yields this result for the area as a whole and for the individual countries except the United Kingdom. My estimates also place the educational quality of British labor below that of the United States, but not every measure yields this result.

Thus, if the education of older Americans is reduced to equivalence with that of recent students on the basis of days of school attended per year, and no similar adjustment is made for the United Kingdom, the average number of years of education in the United States in 1962 falls below that in the United Kingdom (Table 10). Also, if no adjustment had been made for the difference in the age at which school is attended, the quality index using United States weights would be only 2 percent higher in the United States than in the United Kingdom (Table 7), and this could be offset by incorporating the possible adjustment for a longer school year computed in Table 8.

As measured by adjusted years of education, even the United States advantage over Belgium, France and Norway is recent; in 1950 the adjusted United States figure was below them (Table 10). However, this is not a good measure of educational quality since it counts all levels of education equally. Even in 1950 my quality index was higher in the United States.[1]

2. If we use United States education weights, as is most nearly appropriate for an effort to explain differences in real national income valued in United States prices, the difference in educational quality between the United States and Northwest Europe is moderate.

---

[1] Combinations of data from Table 7, Column 3, and Table 6, Part II yields a 1950 comparison based on United States weights. With the United States taken as 100, the indexes for the other countries are as follows: Belgium
Denmark 97.0;
93.3;/France 95.5; Norway 98.0; United Kingdom 99.6; Italy 83.9.

My estimates, given in Table 7, show the quality of labor as affected by education in five Northwest European countries to be 5 to 8 percent below the United States.[1] If we use 7 percent as a tentative estimate for the area as a whole, and a labor share of 80 percent, education of the labor force would account for a difference of about 5-1/2 percent in real national income per person employed, out of a total difference of about 42 percent (of the United States figure). Education of the labor force would then account for one-eighth of the difference.

My final estimate was a compromise between two others, one of which assumed equivalence between individuals receiving the same number of years of education, the other between individuals leaving school at the same age. All three measures yield much the same comparison between the United States and Northwest Europe, but the choice makes a considerable difference for some of the individual countries, particularly Denmark, Norway and the United Kingdom.

If allowance for the current difference in annual class hours in the school year between Northwest Europe and the United States were deemed appropriate, this would eliminate about one-fourth the estimated gap between Northwest Europe and the United States. On the other hand, if allowance had not been made in the United States estimates for poor attendance and a shorter school year outside than within the cities when most of the labor force

---

1. Data in Table 10 show education of current students in Germany to be particularly low, which probably implies that either the level or the growth rate of educational quality of the labor force, or more likely both, are also low. Tentative estimates for the third country omitted, Holland, are also low. The 7 percent gap suggested in the following sentence may therefore be too small.

was being educated, the gap would be about doubled.

I know of no way to assess possible biases due to differences in subject matter or quality of education.

3. The gap between the educational quality of labor in the United States and Northwest Europe is substantially greater if Northwest European education weights are used. This would be appropriate if we were trying to explain the difference between United States and European national income per person employed based on European prices (which is much larger than the difference based on United States prices).

For the comparisons of Northwest Europe and the United States based on years of education, quality indexes using Northwest European weights as well as the indexes using United States weights that were given in Table 7, Column 1, were computed. The two sets of quality indexes are as follows.

	United States Weights	Northwest European Weights
United States	100.0	100.0
Belgium	93.9	87.7
Denmark	88.3	78.4
France	92.5	86.8
Norway	90.7	84.0
United Kingdom	98.0	88.9

The gaps between the United States and Belgium, France, and Norway are increased by about 6 points, while those between the United States and the United Kingdom and Denmark (which are particularly short of individuals at the top of the distribution) are increased by 9 or 10 points. If the differentials in the European education weights I have used are too small, the Northwest European indexes should be even lower.

I have not made a detailed computation based on age of leaving school, and cannot therefore compute accurately a European-weighted index comparable to my "final" United States-weighted index. However, rough estimates suggest that use of Northwest European rather than United States weights would nearly double the gaps between the United States and France, Belgium and Norway as given in Table 7, Column 3, and more than double the gaps between the United States and the United Kingdom and Denmark.

The calculations in this section should not obscure the fact that, by any method of measurement, differences among the United States and the Northwest European countries in educational background are almost trifling in comparison with the differences between any of them and most of the rest of the world. For example, in Turkey in 1960 some 96.7 percent of the labor force 15 years of age and over had 0 to 5 years of education (including 61.5 percent with no education) and the average number of years of education of the labor force was 1.94.[1] The percentage of males 25 years of age and over with 0 to 3 years of education was 62 in Costa Rica, 85 in El Salvador, 87 in Guatemala, 88 in Honduras, and 84 in Nicaragua.[2] Per capita incomes in all these countries are higher than those of countries with most the world's population, and the same is probably true of educational attainment.

4. The difference between the results of using American and European weights in the comparison points up the fact that, even aside from problems caused by inadequate information, the technique I use is less satisfactory for comparing countries than for measuring changes within a country.

---

[1] OECD estimates based on the Turkish Census for 1960.

[2] Committee for Economic Development, Economic Development of Central America, New York, 1964, p. 35.

Given adequate information the weighting technique gives satisfactory and unambiguous results in comparisons of two situations in which earnings differentials by education and the general shape of the educational distributions are similar. These conditions appear to be well met in comparisons of the same country at dates not too far apart. They are not met in comparisons of the United States and Europe. This is reflected in the difference between the results of using American and European weights.

The education weights used should correspond to the price weights used in comparing national incomes. One reason that relative product prices differ among areas is that the relative prices of labor with different educational backgrounds differ, and that the composition of labor (by education levels) entering into different products varies. It is for this reason that I use United States weights in the comparison. But this selection may not completely avoid the difficulties, which are inherent.

5. The diversity of educational backgrounds among Americans must be an advantage in that it provides broad opportunity to match the education of workers with educational requirements for different types of work. The uniformity of the level of education of the bulk of European, and especially British, workers may imply that individuals in the occupations least demanding of educational background have more education than contributes much to their performance, and almost surely implies that in the more demanding occupations the European countries must often make do with workers having much less education than would be advantageous or else be content with fewer workers in the occupation. As between two distributions of the labor force by amount of education that yield the same quality index, there is reason to think that, within limits, the distribution with the greater dispersion is the more conducive to a large national income.

If the British compulsory school-leaving age had, in the past, been about one year higher than it actually was, the "final" British educational quality index, in United States weights, would probably now be about equal to the present United States index. The point of concentration in the British distribution would be higher than it is, but the numbers with advanced secondary and higher education would not be larger. For the reasons just given I doubt that this would have made the British labor force as well adapted to high production (measured in United States prices) as the American labor force, despite the equality of the index.

I suspect the quality indexes based on United States weights do not take the American advantage in dispersion sufficiently into account, and that their use leads to some understatement of the amount of the difference between United States and European national incomes that is due to the education of the labor force.

6. The educational quality of the labor force in Italy is far below that in the United States, and this accounts for a sizable fraction of the difference in output per man.

My "final" education index for Italy, in United States weights, is only 81 percent of the American index in 1960.[1] Using a labor share of 80 percent, this would account for a difference of 15 percent (of the United States level) in real national product per person employed out of a total difference of 59 percent.

If any allowance were made for the unusually short duration of the Italian school year, the gap between the United States and Italian education indexes would be even larger.

---

[1] It is perhaps worth noting that the minimum possible value for this index, given the United States education weights and the computed quality of United States labor, is 63. This is the figure that would be calculated if no one in Italy had any education.

A comparison of the United States and Italy based on Italian weights has not been made, but it is evident that use of Italian weights would yield a gap between the United States and Italy far greater than does use of United States weights.

Relationship between Level and Growth, and Future Trends

Education is typical of the situation where an equivalent increase in a resource contributes more to the growth rate in Europe than in the United States because it is scarcer. Since, by reference to the United States, highly educated persons (and especially those with educations equivalent to American high school or junior college graduates) are particularly scarce in Europe and the ratio of their earnings to average earnings high, this difference is larger the more an addition to the European educational stock serves to increase the dispersion in the distribution.

However, education of the labor force is not a characteristic with respect to which Europe has been closing a gap between itself and the United States. From 1950 to 1962 the gap was increasing. Also (based on United States weights) the educational quality of Northwest European labor was about the same in 1960 as in the United States as recently as 1950, and much above that of the United States in 1926 when real national income per person employed was at about the 1960 Northwest European level. A rough estimate would put the United States index in 1926 at about 81 (United States in 1960 = 100) which is much below the 1960 indexes of 92-95 for five Northwest European countries and only equal to the 1960 Italian index. 1/

---

1. The extrapolation from 1950 to 1926 is based on my earlier study, but after sharply reducing the adjustment for days of schooling in accordance with changes introduced in the present study.

Available information suggests that the educational quality of labor in the United States will rise during the sixties about as much as it did in the fifties while in the Northwest European countries the rise will be more rapid in the sixties. Projections indicate the average rate of increase in the education quality indexes (in Northwest European weights) will be higher in the seventies than the sixties by .15 to .18 percentage points in Belgium, France, and the United Kingdom, and by .05 points in Norway.[1]

A final calculation gives one clue to where the different countries are heading in the longer run. This is the amount by which the average years of education being provided recent students (as of 1957-58) exceeds the duration of education of the 1962 labor force.[2] The average education of recent students exceeded that of the labor force by 3.9 years in Italy, 2.5 in Belgium, 2.2 in France, 1.6 in Norway, 1.2 in the United Kingdom, and 1.0 in Denmark. (The figure for the United States is 2.0 years if the labor force average is not adjusted for a shorter school year in the past, and 3.5 years if it is.) The order among the Northwest European countries -- Belgium first,

---

1. The statement with respect to the United States is based on previous projections by the author. A projection of the education of the labor force being prepared by the United States Department of Labor will provide the basis for a better estimate. Estimates for the European countries are all deduced from projected changes in the average number of years of education; data are given in the notes to this chapter. An alternative estimate by the Working Group at the University of Brussels shows a much larger acceleration between the fifties and sixties in Belgium than is indicated above (See notes to this chapter.).

2. Table 8 gave estimates of the average number of years of education being received by students in 1957-58. The average for the labor force in 1962 (for this purpose I use a simple average of males and females) was given in Table 10.

followed by France and Norway, and then the United Kingdom and Denmark -- is the same as that for the increases in the quality of the labor force in 1950-62.

EDUCATION AND EARNINGS: A CASE STUDY

In the following preliminary manuscript are a discussion of the literature which this study hopes to enrich, a description of the survey undertaken for this case study, and a qualitative discussion of most of the variables used. Most of the actual computations and their results will be presented on Monday, November 7, at Professor Hanson and Professor Weisbrod's Seminar.

Daniel C. Rogers
November 2, 1966
Not for quotation.

The study of the nature of income distribution is a time-honored one in economics. All of the major classical writers discussed the division of income both among the factors of production and among the owners of those factors. Smith listed five determinants of the size of wages for any job: the agreeableness of the work, the difficulty and expense of learning how to perform the job, the constancy of employment, the responsibility taken by the employee, and the probability of success.[1] Others modified or argued against these factors. Mill, Marshall and Taussig all discuss what makes wages for different jobs unequal.[2] In the latter part of the nineteenth century and the first half of the twentieth century, however, concern seems to have been centered on the distribution of income among the factors of production and its consequent distribution between people on the aggregate level.[3] In the last decade, new interest has been generated in the causes of income inequalities and the size of the contribution to that inequality of these various factors. In particular, there has been a great deal of discussion about the effect of education on individuals' and nations' incomes and about the causes for specific individuals being in the lowest income group.

In part, this interest was an offshoot of the analyses of the nature of production by Solow and others which try to determine what proportion of the total product is due to capital, and what proportion to labor. It was found that additions to capital and labor did not explain all of the increase in national income. In pursuit of an explanation for this, many turned to the contribution of education, regarding expenditures on education as an investment in "human capital." Such an apporach is, of course, not an original one. Smith may again be profitably quoted in this regard:

> A man educated at the expense of much labour and time to any of those employments which require extraordinary dexterity and skill, may be compared to one of those expensive machines. The work which he learns to perform, it must be expected, over and above the usual wages of common labourer, will replace to him the whole expense of his education, with at least the ordinary profits of an equally valuable capital. It must do this too in a reasonable time, regard being had to the uncertain duration of human life...[5]

Since it was recognized from the first that many factors contribute to the size of an individual's earnings,[6] attempts have been made to quantify the portion of the difference between earnings that is attributable to each of the factors. Never-the-less, in his recent Book, Human Capital, Becker still puts at the top of his list of suggestions for further research these comments:

> Economists have been surprisingly ignorant of the quantitative effects of different kinds of ability on earnings and productivity, yet such knowledge is essential in estimating the gains from investment in human capital (and in resolveing many other problems as well). The surveys utilized in this study [many of the studies that are discussed in section one] show the feasibility and importance of determining these effects, and many more such attempts should be made in the future.[7]

This study shall attempt to further analyze the quantitatige importance of education and intelligence for earnings. The differential effect of education on individuals of different ability and the effect of adding high school to primary education will be stressed. In the process much information will be generated about the influence of other factors on earnings. From these data it is hoped that more accurate ideas of the effect of educati will become available to school counsellors and "Poverty Program" planners, which will aid them in advising their students and making their plans. The aim of this study, then, is to shed light on sub-obtimization decisions within education rather than optimization between education and other expenditures, both for the individual and for society.

Some of the more important attempts to determine the contribution of education and other factors to the individual's income should preceed detailled description of the present study. From them various hypotheses and estimates of effects can be derived and tested in this study.

FOOTNOTES

O:1

1. Adam Smith, *The Wealth of Nations* (New York: Modern Library, 1937), p.101.
2. Mill asserts that Smith's schedule of wages is almost upside down since the least able have no choice but to take what is offered to them when there is not full employment. Thus they get the meanest labor at the lowest wages. He also argued against Smith's assertion that higher wages were a compensation for increased responsibility. The reward associated with trust is rather a return to a natural monopoly, he feels. J.S. Mill, *Principles of Political Economy* (London: Longmans, Green & Co., 1909), pp. 388,391.

Marshall adds to Mill's comments on the lowest wage going to the meanest labor in blaming science for keeping alive people who cannot do any but these jobs, thereby keeping the wage down through excessive supply. The differential investment of capital in individuals, he asserts, is another reason for wage inequalitites. Alfred Marshall, *Principles of Economics (8th ed.; New York: Mac Millan Co. , 1953)*, pp. 558, 562 & 564.

Taussig dogmatically simplifies the question: "The causes of inequality are reducible to two: first, inborn differences in ability; and second, the maintenance of acquired advantages through environment and through the inheritance of property." F.W. Taussig, *Principles of Economics* (4th ed.; New York: Mac Millan Co., 1939), *2*, p. 297.

3. In his preface to Inequality of Incomes, Dalton observes that, "...most 'theories of distribution' were almost wholly concerned with distribution as between 'factors of production.' Distribution as between persons, a problem of more direct and obvious interest, was either left out of the textbooks altogether, or treated so briefly, as to suggest that it raised no question which could not be answered either by generalisations about the factors of production, or by plodding statistical investigations. Hugh Dalton, *Some Aspects of the Inequality of Incomes in Modern Communities* (London:George Routledge & Sons, 1920), p. vii.
4. Robert M. Solow, "Technical Progress, Capital Formation and Economic Growth," *American Economic Review*, Proceedings (May 1962), *52*, 76-86.

O:2

5. Smith, p. 101.
6. For example, Marshall commented p. 577: "And there is some interest in the inquiry how much of the income of successful men is due to chance, to opportunity, to the conjuncture, how much to the good start that they have had in life; how much is profits on the capital invested in their special training, how much is the reward of exceptionally hard wrk; and how much remains as a producer's surplus or rent resulting from the possession of rare natural gifts."
7. Gary Becker, *Human Capital* (New York: Columbia University Press, 1964), p. 157.

There have been a great number of articles written during the last decade which deal with the relationship between education and income. These studies can be divided into two main types: the "census" study, which uses as a primary source data which have already been cross-tabulated, and the case study, which has original individual data, suitable for multi-variant analysis, as its primary source. The case studies tend to be based on much smaller groups than the "census" studies. Tracing the development of these studies will be useful in introducing the present study as well as the problems on which it hopes to shed light.

CENSUS STUDIES

In the "census" type studies, data is generally either taken from the government census or from some probability sample of the population of a country. Those using the United States Census data are limited in their potential breakdown of the data to median income for age and education intervals by sex and race.[1] The first of these was Glick and Miller's path-breaking work in 1956, "Educational Level and Potential Income".[2] They estimated the increment in income corresponding to an increment in educational level for a specific group of men, those between 45 and 54 years of age in 1949, and found that the increment for an additional year of education rose rather steadily as educational level increased.[3] They also calculated "lifetime income" for men of various educational levels who were 22 years of age in 1949. With the assumption that each educational group had the same survival rate as that of the white males of 1949, lifetables were used to estimate the proportion of the cohort which would be alive in each year of the future. They then ascribed the mean income (as estimated from the median) of each age group to that proportion of the cohort still surviving, thus arriving at the desired figure for educational level.[4]

Next they estimated the cost of college education[5] and calculated the "return" to that education, i.e. the additional income that a college graduate receives over that of a high school graduate (total income of the college graduate minus the total income of a hgih school graduate). They showed that this is much greater than the same money invested in government bonds would earn, even if reinvested, which the earnings differential is not. This analysis is the source of the oft quoted, "A college education is worth $100,000." The authors claim only that the $100,000 represents the increment in income for a hypothetical group of white males who "live" a life with the same amounts of income at each age as the mean income of the population in that age interval in 1949.

Considering the assumptions, especially those about the constancy of income over time, and the use of income rather than earnings, it is indeed unfortunate that some have presented this as the actual rather than the hypothetical value of a college education. It should be made clear that Glick and Miller do point out the unreality of the assumptions and attempt to forestall any such use of their analysis. That this figure has so often been misused in spite of the authors' warnings attests to the interest in this type of study.

There have been many attempts to improve on and extend Glick and Miller's calculations and methods. In a 1959 article, Houthakker took the same data that they used and reworked it.[6] He used different means (trying to correct for the skewness of income distributions) and extended the span of "lifetime earnings" to age 14 on the one hand and ages 75 and over on the other. He then attempted to capitalize the incremental income corresponding to increments in education, which is a step towards putting the gains associated with education into perspective. This increment was capitalized at zero, three, six, and eight percent both before and after having deducted an estimate of Federal income tax. He showed that the "gain" seen between one educational level and another is very sensitive to discount rates, as one might expect given the long period over which this gain is stretched. One might query in this regard his use of 14 years as the beginning point for his calculations, as this is even below the minimum school attendance age in most states,[7] and consequently substantially reduces the capitalized income increment.[8]

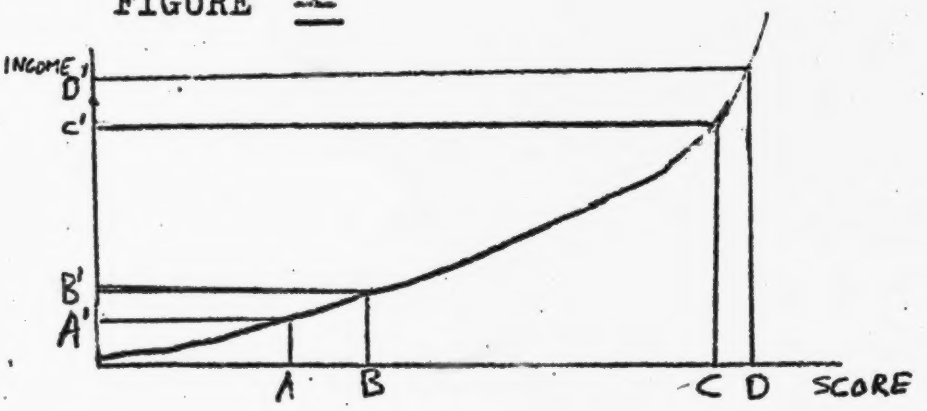
How differences in ability affect the increment in income attributed to education is brought by Bridgman into this line of analysis in a tangential manner.[9] Taking figures from the 1956 Current Population Survey, he computes separate lifetime incomes (age 25 to death) for high school graduates and for college graduates. Bridgman works with median incomes instead of means,[10] but he also gives lifetime income figures for those at the 25th and 75th percentile of the income range. He shows that the advantage of the college graduate over the high school graduate increases as one moves up the income scale. That is, the ratio, $\frac{\text{college graduate income}}{\text{high school graduate income}}$, increases from 1.34 through 1.46 to 1.54 as one moves from the lowest quartile of income for each group to the highest.[11] Looking at a specific group, those 35-44 years of age in 1956, he finds the same pattern.

In addition Bridgman presents scores for some 110,000 enlisted men who took the Army General Classification Test in 1944 and 1946, assuming that these men were comparable in age to the 35-44 age group in 1956. When one compares the marks of those high school graduates who were at the 25th, 50th, and 75th percentile of the gigh school graduates in the group to their college graduate counterparts, the former's scores put them at a percentile of those in the nation taking the exam which is 70, 82, and 89 percent of the percentile of the latter group.[12] That is, the difference in ability levels decreases as ability in each group increases.

From these two facts Bridgman concludes that at low income levels the differences in ability seem of far greater importance than the educational differences and at high income the educational difference seems more important.[13] This conclusion does not seem to be the only one consistent with the data if other factors are allowed to be considered. For example, many college graduates may be in the lowest quartile of income of the college graduate group because of choice of occupation rather than low ability. School teachers and clergymen are two obvious examples. Moreover, if, for example, the significance of ability grows in an exponential manner as one moves away from the median, the smaller percentage difference at the high extreme of ability could be as meaningful as the larger difference at the lower intelligence levels.

FIGURE 1

A = HS low
B = college low
C = HS high
D = college high



$^{A}/_{B} < {}^{C}/_{D}$ but $^{A'}/_{B'}$ is not necessarily $< {}^{C'}/_{D'}$

To reinforce his arguement Bridgman reproduces data from a 1930 study of land grant college graduates, which gave median earnings by age of entrance to college, a proxy for ability, the hypothesis being that on an average, the earlier the entry, the greater the ability. This data shows a very regular pattern of the hypothesized sort for those graduates 10, 20, and 30 years after their graduation.[14] Finally, he presents data on salaries of Bell Telephone System employees by college rank and campus achievement, which show an increase in the proportion in the higher salary groups as rank and achievement increase.

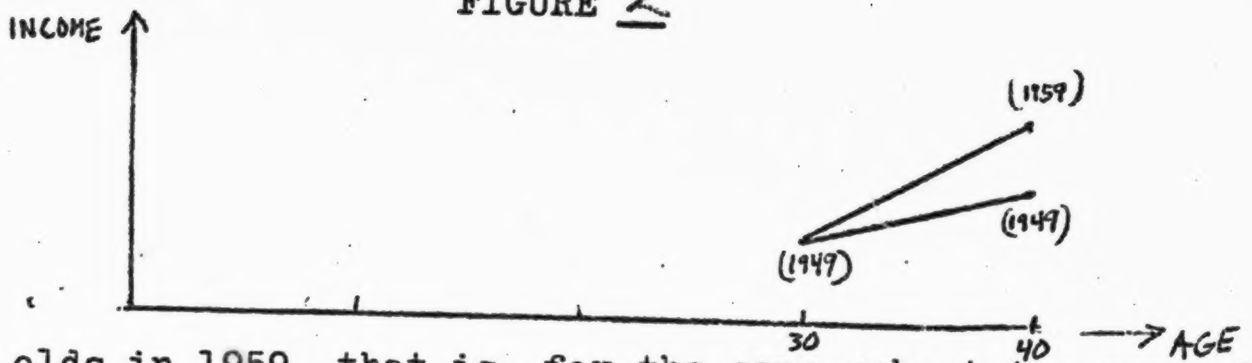
To summarize, Bridgman has three groups of data which suggest that greater ability is associated with higher income. None of these however, is directly connected with the Census data which he is suggesting needs modification to take ability into account. Therefore the specific adjustment caused by ability differences still cannot be discerned.

In an article indirectly related to these studies, Schultz estimated the total amount of resources that are and have been used in education, in an attempt to determine the amount of "human capital" then extant in the United States.[15] His method was to estimate the direct expenditures on education and the foregone earnings of those who untertook it, and he claimed that the sum of the two equals the amount of human capital.

Herman Miller has contributed two further articles extending the analysis of the Glick-Miller article of 1956. In the first, he compares the lifetime incomes of men for 1939, 1946, 1949, 1956, and 1958 data, using the same method that was described above.[16] He concludes that, "Although the income levels have changed considerably during the past 20 years, the basic relationship between the extent of schooling and income appears to have remained much the same."[17] Unfortunately, however, the 1939 figures are for earnings of those with not more than $50 income from sources other than wages and salar, which cuts out most people who were in business for themsleves and, obviously, anyone who had interest, rent, unemployment compensation, profits, capital gains, and so forth of more than $50; the 1946 data is for all earnings; and the data for the last three years is for all money income.

In a 1956 follow-up Miller relaxes the assumption of constant income distribution among age groups, which was used in the calculation of lifetime income, since he has available 1950 and 1960 census data.[18] He shows that the increase in income associated with the difference in age between the 25-34 and 35-44 years old in 1949 groups is less than the increase the 25-34 age group actually received as seen in the income data for 35-44

FIGURE 2



year olds in 1959, that is, for the same cohort ten years later (neglecting international migration). Thus the earlier method underestimates the amount of income associated with increased income that actually occurs; not an unexpected result.

CASE STUDIES

In this subsection, both those case studies which specifically attempt to determine the effect of education on income and those which have data that can be directed to this purpose (even though this is not the objective of the particular study) will be discussed. Where relevant, the procedures used in them as well as their findings will be compared in greater detail with those of my own study (see section).

1. Wolfle and Smith's article analyses 3641 responses to questionnaires sent to superior high school graduates in 1955, some 17 to 20 years after their high school graduation.[19] Since at best it only shows median income for each cell of a two variable matrix, this study has greater resemblance to a "census" study than to a case study. One table, for example, shows median income by rank in high school class and education and a second shows it by IQ level and education. Thus, one can never determine the simultaneous effect of IQ, class rank, and education on income.

Their study is included here because the data for a true case study was available, even if it was not used, and several breakdowns of the data are presented which are significant for my own study. Questionnaires were sent solely to students who were thought to have a reasonably good chance of succeeding in college, because of their class rank or IQ. Any conclusions to be garnered from Wolfle and Smith's study must therefore be limited to the benefits to superior students of post high school education. Although other data was gathered (see table), only information grouped by IQ, class rank, or father's occupation is cross-referenced with education and earnings.

Wolfle and Smith arrived at several relevant conclusions. With class rank held constant, a college degree is associated with median earnings of $1,100 to $2,500 a year more than the high school degree, the higher amount being for the highest ranked group (91-100) and the lower amount for the lowest (mostly 40-60). In a sub-group which was divided into three IQ classes, those who had graduated from college were observed to have median earnings which were $1,100 to $2,300 greater than those who had merely completed high school within any IQ group. The difference between the highest and lowest IQ groups' median ranged from a minus $300 to a positive $1,100, going from the lowest to the highest educational group.

They summarize these findings by pointing out the combination of superior ability, be it either high IQ or high class rank, and a high level of education fare much better than those who have only one of these two attributes. When father's occupation, which, they suggest, is a proxy for social class, is held constant in broad categories, a college degree is associated with from $2,000 to $2,400 higher median earnings; holding education constant, the sons of farmers make from $200 more to $1,600 less than those whose fathers are in other occupations. These are all gross effects, that is, the $1,100 more for college graduates in a specific IQ group than for high school graduates in the same group does not take into account any other ways in which the two education-IQ groups differ.

To a great extent, Wolfle and Smith's research provided the inspiration for the present study. Their inadequate use of the data, however, is not the only justification for a new study being undertaken. The effect of education at its lower levels and on individuals of lesser ability could not be determined from this data, due to its intrinsic nature rather than inadequate handling. Since there is no source of data extant which meets these needs, this study was undertaken.

2. Basing his study on a "selected part" of the 1950 to 1953 Surveys of Consumer Finances' representative sample of "approximately 3,000 American spending units," Adams performed tests to determine what effect, both quantitatively and qualitatively, selected socio-economic variables and certain combinations of them had on the earned income of white males.[10] In variance analyses he found that each of the simple variables significantly affected income at the one percent level of significance, but that none of the compound variables he used did so. In addition he derived the following equation for the 1950 interviewees (1949 income)

through a multiple regression:

$$\mathrm{Log}_{10}Y = 2.6459 + \underset{(.0188)}{.2003A} - \underset{(.0028)}{.0271A^2} + \underset{(.0120)}{.0555E} + \underset{(.0100)}{.1351J} + \underset{(.0142)}{.0548L}$$

$$+ \underset{(.0094)}{.0598L} + \underset{(.0134)}{.2105P}$$

Where Y = Wage and salary income
A = Age in 6 groupings ranging from 18-24 through 65+
L = Region dummy which equals 1 if not South
C = Community size with 0 being open country and 1 and 2 communities less than or greater than 50,000 respectively
P = Part of the year worked; 0 if lessthan 11 months, 1 otherwise.
E = Education defined as: 1 = hish school or less for white collar occupations; grade school or less for blue-collar occupations; 2 = college for white-collar and high school or above for blue-collar occupations.
J = Occupation equalling o,1, and 2 for unskilled and service; semi-skilled, skilled, clerical, and sales; and managerial and professional respectively.[21]

The regression equation explains 43 percent of the variance. Several of the variables are framed rather unusually. Occupation, divided into only two sub-groups, is used in defining education, itself similarly divided. This attributes to education explanatory power which may actually belong to ability, ambition or other variables: Having different amounts of education in the same job does no necessarily indicate education's effect on individuals; more likely it reveals the effect of these other factors. The occupation variable is defined in a manner which similarly detracts from the effect of education and the other factors. Professionals, for example, have higher income partly on account of their educations and abilities. Thus the use of both the educational and the occupational variables undervalues the contribution of education to earnings. in sum, Adams' handling of the data here seems to obscure rather than define the effect of education on earnings.

3. The Morgan, David, Cohen and Brazer book, *Income and Welfare in the United States*, analyses data from interviews with 2997

spending unit heads in 1960.[22] Since the total group was representative of the population of the United States as a whole, the successful interviews were weighted so as to maintain this representativeness. In an attempt to control for the effect of the quantity of work on earnings, they used hourly earnings as the factor to be explained by the socio economic variables they collected. To attain hourly earnings for those who reported earnings on an annual basis, they subtracted six percent of invested capital from the earnings of farmers and others who were self-employed and then divided annual earnings by the average number of hours per week which were worked by the given individual. Using dummy variables exclusively, they found that education and age, sex, occupation, movement out of the Deep South, the extent of unemployment in the state of residence, supervisory responsibility, "attitude toward hard work and need-achievement score," race, "interviewer's assessment of ability to communicate," and geographic mobility were all significantly explanative of hourly earnings at the five percent level, with all but the last significant at the one percent level. Physical condition and "rank and progress in school" (grades and whether or not the person was behind in age when he left school) were not significant.

In explaining hours worked, which yields an estimate of annual earnings when combined with earnings per hour, they found "Adult unit composition," education and age, occupation, hourly earnings, physical condition, and plans to help parents or children significan at the one percent level and attitude toward hard work and need achievement score, religious preference and church attendance, and race significant at the five percent level. Extent of unemployment in the state, differences between education of the heads and wives, and immigration of heads and their fathers were found to be insignificant.[23] Very much the same picture is generated when the hourly earnings of only the white male non-farmer spending unit heads who worked in 1959 are analyzed. Attitude toward hard work and need-achievement score as well as the interviewer's assessment of ability to communicate are no longer statistically significant and physical condition becomes a significant explanatory variable for this subgroup.[24]

The authors present their results quantitatively through tables of the "unadjusted" and "adjusted" deviation from the mean of the entire group associated with any given factor. The "unadjusted" deviation indicates the gross effect of the factor while the "adjusted" effect indicates the part which is due solely to that factor after controlling for all other variables which might be associated with it to a greater or lesser degree. For example, the gross effect of being female is a decrease of 75¢ in hourly earnings, but the adjusted effect is a decrease of 78¢, because women's other attributes (their education, occupation, etc.) differ from men's so as to contribute to an additional decrease in their hourly earnings. The effect on income of differing amounts of education is not forced to be the same for each group. Thus, for example, college education is not constrained into affecting earnings by the same amount for those in the 25-34 age group and those in the 45-54 age group. Their use of the interviewer's opinion of the interviewee's ability to communicate as a proxy for intelligence attempts to conpensate for the lack of a variable indicating ex ante relative ability. This ability to communicate results partly from education[25] and is, as they themselves admit, a very poor indication of ability.[26] The use of supervisory responsibility does not seem to be justified as an independent variable in explaining earned income because it, just as the skilled-unskilled, etc. breakdown of occupation used by Adams, is too much a result of all the other variables which determine the job one has and the pay it justifies.

4. Shane Hunt's dissertation and the article which excerpts from it are directed toward investigating various factors in relation to college education.[27] His data is derived from a 1947 Time magazine survey of a sample of all college alumni for whom colleges had some address. Hunt used 2625 from the original 17,053 who were polled. The group is, of course, biased in favor of graduates of large and well financed colleges because these colleges generally maintain superior alumni records.[28] The following simple variables were found significant at the five percent level: years since graduation, graduate school attendance, expenditure per pupil in college, self-employment, extent of extra-curricular activities in college, extent of self-support in college, and the log of the enrollment of the college attended. The following compound variables were also significant: ability with years since graduation; medicine, government, and education as professions each with years since graduation; business as an occupation with city size; and and business as an occupation with mother's education. Variables which were not significant include race (there were very few non-whites, probably due to the selection process mentioned above),

father's education, mother's education, and various other combinations of the variables.

His ability variable is extremely ingenious, although equally tenuous where great accuracy is needed, since many of his assumptions require that the average mirror the individual. His basic data are the average grade and department of concentration reported by the student on the questionnaire,[29] the average grade of all students in all departments of certain colleges, which are assumed to be applicable to all colleges, and finally the average grade of students entering specific colleges in 1952 on one of several tests of scholastic ability which were reduced to a common scale. This is indeed an "iffy" sort of measure of ability; on an average it is probably better than the simple unadjusted grades, but its use to determine the effect of individuals' ability on their incomes is open to more question. Both the simple grade average and the adjusted grade average used by Hunt are unreliable proxies for an individual's ability, due to the great differences in difficulaty between specific courses selected, both in the major and as electives. There is also the problem of the accuracy of the questionnaire, since responses were made in some instances fourty or fifty years after graduation and the difference between recorded answers of "A" and "B", for example, is so great. On an average, it makes no difference if one person with half A's and half B's records A and the other B, but when individual variations are being analysed, this is no longer true.

5. With a sample of 238 persons who were heads of households, had less than a college education, were 21 years of age or older, and had been interviewed in 1957, Hirsch and Segelhorst undertook

a multiple regression analysis.[30] Income was their dependant variable, while dummy variables for race, sex, self-employment, migration from the Deep South, education per pupil, expenditure on education, occupation, occupation of father, age, and size of birthplace were their independant variables. They found race, sex, years of schooling, occupation and a self-employment combined with supervisory status variable to be significant at the five percent level or better. They then estimated the lifetime incremental income associated with an additional year of primary-secondary education "on the average". This procedure obscures some of the data in order to make a more general, but less meaningful statement; it would have been better to make the general statement after showing specific results for each year of education, thereby making maximum use of the data. Two other factors severely limit the value of their results: their use of income instead of earnings and the absence of any measure of ability.

6. In 1959 the fifth volume of Genetic Studies of Genius was published.[31] It describes a group of 1528 men and women whose lives have been closely followed since the 1920's. An immense quantity of data has been collected about these people, all of whom had IQ's of 135 or more. Some data on the income of members of the group for the year 1954 are included in this volume. Earned income is presented by number of individuals in age and income ranges, by the number in educational levels and income ranges, and by median income in 28 occupations. The only conclusions asserted about the income of the genius group is that the median earned income of those who were roughly in the same

group as "Professional and semi-professional" and "Managerial," as presented in the *Statistical Abstract of the United States*, was $10,556 as compared to *total income* medians of $6,020 and $%,800 respectively for the whole population. For the gifted group roughly in the "Clerical and sales" and "Skilled and semi-skilled" categories, the median *earnings* was $5,750, while the population as a whole had medain *total incomes* of $3,980 and $4,390 respectively.[32] This does not take into account the education differential between this group and the general population. Using this sparse data, I calculated an estimate of the mean income by educational level, which is done below, to estimate the additional income associated with this high intelligence level, holding only education constant.

There are two sources which present income by education for the whole population. Miller's article of 1960 and the Morgan, et al., probability sample (see above pp. 6f. & 10f.). The Miller study gives total income for 1956 rather than earnings by age groups and the Morgan, et al., book gives the deviation from the mean of the sample (through a regression analysis as described above) for hourly earnings, hours worked, and labor force participation by age and education. Their product gives expected annual earnings. Making the assumption that the proportion of the genius group having each level of education does not change with age, I applied weights derived from the proportion of the genius group in each age group, to the Miller and Morgan figure in order to attain one average income figure for all ages of each educational leve[1]. In the form found below, comparisons are possibl between these groups.

TABLE 1

	(1)^{a}	(2)^{b}	(3) (1)/(2)	(4)^{c}	(5) (1)/(4)
High school graduates	\$10,050	\$4,880	2.06	\$5,910	1.71
Some college, no degree	\$ 9,980	\$5,980	1.67		
College degree(s)	\$15,060	\$8,970	1.68	\$8,820	1.70
$\frac{\text{College}}{\text{High school}}$	1.50	1.84		1.49	

(a) Terman, op. cit.

(b) all income reduced by $\frac{\text{Consumer Price Index of 1954}}{\text{Consumer Price Index of 1956}}$, Miller article, 1960, op. cit.

(c) earnings reduced by $\frac{\text{Consumer Price Index of 1954}}{\text{Consumer Price Index of 1959}}$, Morgan, et al. op. cit.

These figures suggest that greater ability is associated with from a 67 percent to a 106 percent higher income than that of the population as a whole. The Miller data is the less meaningful comparison in terms of the income covered; however the Morgan et.al. data is for a later date than Miller's and my price change correction understates the effect of time due to the growth of the economy.[33] In addition, Morgan, et.al.'s data represents only a relatively small probability sample of the population while Miller's is based on the full Census. It is interesting to note that the genius group did not have a larger percentage increase from going to college than did others (less if we use the Miller data) and actually took an absolute loss in earnings if they went to College but did not graduate.[34] The absolute increase in earnings is larger for the genius group. Their rather high absolute earnings can be partially explained by the genius group's having more education than the general population at each educational level.[35] In sum, this evidence suggests that those with 135 IQ or above have a decided (70 to 100 percent higher) earnings advantage over other people, holding only education constant, and college adds absolutely but not proportionally more to their incomes.

7. Another study is deserving of brief mention. The Thorndike-Hagan book, Ten Thousand Careers, gathered extensive data about a group of men in the armed services in 1943 who volunteered for aviation cadet training.[36] These men were well above average in intelligence and had education which averaged more than high school graduation. They had an average of 33 years when the survey was made, so they were not yet at prime earning age and they had had but a short work experience. Extensive tests were administered in 1943 including biographical questionnaires. Mainly through extensive military records, about 70 percent of the original 17,000 subjects were traced in 1955 and answered questionnaires. Thorndike and Hagan found that correlations within finely divided occupational groups between biographical and test data and "last monthly salary" were in general so low as to be considered due to chance. Instead of using multiple correlations to determine the controlled effect of various of these factors on earnings, they proceeded to disparage the usefulness of earnings as a measure of success. Thus, this body of data was not applied to the question of the determinants of earnings, even though it might profitably have been put to such use. Since no earnings data was presented in the book, I was not able to undertake even a bare attempt at salvaging some information on this question.

8. Project Talent, under the direction of John Flanagan of the University of Pittsburg, is an undertaking which will generate excellent data that could be used for a case study analysis.[37]

The lives of 440,000 students who were in the ninth through twelfth grades in 1960 are being followed. Assuming that even a few questions on income are included in its extensive questionnaires, it will be possible to specify the effects of education and ability on earnings better than any previous attempts could do. It is to be hoped that an economist interested in the economics of education will have the opportunity to design questions for inclusion in this tremendous project. This data, in any case, will not be available for 20 years, since the careers of these students lie in the future.

1:1

FOOTNOTES

1. For example, the median income for Negro men between 35 and 44 years of age with one to three years of college was in .

2.

3. Glick and Miller, p. 309 (MEAN INCOME) and p.310 (INCREMENT PER YEAR)

EDUCATION	MEAN INCOME	INCREMENT PER YEAR OF EDUCATION
NONE	$58,000	
1-4	$72,000	$136
5-7	$93,000	$165
8	$116,000	$303
9-11	$135,000	$238
12	$165,000	$266
1-3 (college)	$190,000	$477
4+ (college)	$268,000	$974

1:2

4. They apparently used a formula such as the following, after mean income had been estimated from the median:

Where: Y_j = lifetime income of the jth educational level
$Y(i - i+n)$ = mean income of age group from i to i+n for jth educational group.
Y_{ij} = probability of someone in the jth educational group and i+1 years of age.

5. Glick and Miller, p. . They calculated: college ($7000) plus one-half year graduate school ($1000) minus $4\frac{1}{2}$ years of subsistance ($2700) plus $4\frac{1}{2}$ years of foregone earnings ($3600) equals cost of $4\frac{1}{2}$ years of college ($9000).

6. H. S. Houthakker, "Education and Income," Review of Economics and Statistics, 41 (February 1959), pp. 24-48. 1:3

7.

8.

9. D.S. Bridgman, "Problems in Estimating the Monetary Value of College Education," Review of Economics and Statistics, 42 (August 1960), pp.180-85.

10. Bridgman argues that medians are the more meaningful measure here. The arguement, however, has been rejected by most observers. See

1:4

11. Bridgman, p.180. Derived from Table 1.
12. ibid., p.181. Derived from Table 3.
13. ibid., pp. 181-82.
14. ibid., p. 182.

1:5

15. Theordoere W. Schultz, "Capital Formation by Education," Journal of Political Economy, 68 (December 1960), pp. 571-84.

16. Herman P. Miller "Annual and lifetime Income in Relation to Education; 1939-59,"American Economic Review, 50(December 1960), pp. 963-86.

17. ibid., p. 965.

18. Herman P. Miller, "Lifetime Income and Economic Growth," American Economic Review, 55 (September 1965), pp. 833-44.

19. Dael Wolfle, and Joseph G. Smith, "The Occupational Value of Education for Superior High-School Graduates, Journal of Higher Education, 27 (April 1956), pp. 201-212.

20. F. Gerary Adams, "The Size of Individual Incomes: Socio-Economic Variables and Chance Variation," Review of Economics and Statistics, 40 (November 1958), pp. 390*98. This article is based on Adams' Some Aspects of the Income Size Distribution: A Statistical Study, unpublished Ph.D. dissertation, University of Michigan, 1956. For the reader's convenience reference will be to Adams' article unless otherwise stated.

21. ibid., p. 394.

22. James N. Morgan, Martin H. David, Wilbur J. Cohen, and Harvey E. Brazer, Income and Welfare in the United States, (New York: McGraw-Hill Book Company, Inc., 1962), Hereafter cited as Moran, et.al.. For a more concise presentation, directed specifically to education's effect on earnings, see: James Morgan and Martin David, "Education and Income," Quarterly Journal of Economics, 77, (August 1963), pp. 423-437; hereafter cited as Morgan and David.

23. Morgan, et al., p. 73.

24. ibid., p. 61.

25. Becker, op.cit., footnote 25, p. 86.

26. Morgan and David, op. cit, p. 429.

27. Shane J. Hunt, "Income Determinants for the College Graduate and Return to Educational Investment," Yale Economic Essays, 3 (Fall 1963), pp. 305-58. This article is the test of Hunt's unpublished Ph.D. dissertation by the same title (Yale University, 1963), but does not include its appendicies. Reference will be make to the article unless otherwise specified.

28. ibid., p .

29. The question was:"As well as you can honestly remember, were your grades in college mostly: D C B A?" Patricia Salter West, The College Graduate in American Society--A Survey Analysis, unpublished Ph.D. dissertation,(Columbia Univeristy, 1951), appendix , p. .

30. Werneer Z. Hirsch and Elbert W. Segelhorst, "Incremental Income Benefits of Publ ic Education," Review of Economics and Statistics, 47 (November 1965), pp. 392-99.

31. Lewis M. Terman and Melita H. Oden, Genetic Studies of Genius (Stanford: Stanford University Press, 1959),5, The Gifted Group at Mid-Life.

32 ibid., p. 97.

33. See Miller's 1965 article described above and Yoram Ben-Porath, "Lifetime Income and Economic Growth: Comment," American Economic Review, 56 (September 1966), pp. 869-872.

34. Starting and not finishing college is probably a stronger indication of some sort of personal problems for the genius group than for the population as a whole, since these people surely have the necessary intelligence to succeed.

35. Sixty-nine percent of the college graduates went on for further formal education; sthirty-nine percent of all the college graduates received Ph.D.'s, LL.B.'s, or M.D.'s. Over a third of those listed as high school graduates also had courses at trade, business, technical, art, or other specialized schools. These are higher rates than those of the population as a whole. Perman, p. .

36. Robert Thorndike and Elizabeth Hagan, Ten Thousand Careers (New York: John Wiley, 1959).
37. John C. Flanagan, etal., Project Talent: The American High-School Student, (Pittsburg: Project Talent Office, University of Pittsburg, 1964

An ideal set of data for a study which is to determine the effects which both various levels of education and ability can have on earnings would have three essential ingredients. It would have an accurate measure of ability, preferably intelligence and achievement test scores.[1] It would be for a group of males which has an extensive earnings history, being at prime earning capacity or older at the time of the study, so that the effect of education over a long time span could be observed.[1a] For a study in 1966, one would like to have a group for which all who s desired could have completed college before 1942, in order to minimize the disruptive effect of World War II on their earning patterns. They would, therefore, have had to finish the eighth grade by 1934. Finally, the prospective group should be broadly based, so as to avoid biases. The younger the group was when tested, for example, the less likely that it would be biased either through elimination of less gifted and/or wealthy individuals through failure or necessity of going to work or of more gifted and/or wealthy through their transfer to private schools.

It was very quickly discovered that there are few longitudinal studies for large groups of people. None of these studies have ability measures for a heterogeneous group, selected from among individuals as young as junior high school students. As has been discussed at length above, the Wolfle-Smith study deals with all high school graduates from several cities and the Terman study traces the lives of a group with homogeneously high IQ's. Since there is no adequate body of data on which to base the proposed study, I found it necessary to design my own survey, from which to gather mor comprehensive data.

In planning this survey, one additional constraint had to be taken into consideration. Transportation costs involved in finding school systems with appropriate records had to be minimized, thus limiting me to the Middle Atlantic and New England States. Many school systems did not administer the necessary tests as early as the 1930's. New York City, a logical selection, proved unsuitable because of difficulties with the records, the high mobility, and duplication of names due to the size of the city. I then checked several of the larger Connecticut cities and found that Hartford, Norwalk and Waterbury had sufficient records to be used in the study and were willing to participate in it.

Two concerns led me to search for records from private schools to supplement this public school group. I feared that there would be a disproportionately small number of individuals belonging to the highest intellectual and social strata in attendan at public schools, especially in view of the tendency of a large number of well-to-do people in New England to send their children t private schools. It has also been observed that individuals with very high incomes have a lower response rate to questionnaires, probably because of reluctance to divulge the sources anf full extent of their incomes.[1b] Having too few representatives from the higher eschelon could cause my statistics to be misleading, due to chance selection of one or two unusual people. I ascertained that the Educational Records Bureau in New York City services many private schools in the country with intelligence and achievement tests. Since their service goes back to the thirties and they kindly agreed to assist wherever possible, I was able to find IQ records for several schools in the aforementioned geographical area. Four of these schools permitted me to use their data, thus adding to my sample a group of students who were probably from families of high social class and income.

The difficulties involved in attempting to find IQ test scores for students in elementary or junior high school in the 1930's were extensive. Consequently the group selected for this study is not ideally homogeeneous. Rather, it is composed of parts of classes from three different years. The bulk of the group, however, is the class which was to finish the eighth grade in 1935.

Over half of the sample is from the largest city and capital of Connecticut, Hartford, which had an estimated population of 177,740 in 1935. The great majority, if not all, of the schools which had eighth grade classes are represented. Since there were no Catholic administrated high schools and all those who entered the public high schools had to take the same intelligence and achievement tests, the students were from both public and Catholic schools. This part of the sample represents about two thirds of the males of the January and June eighth grade graduating classes of 1935, i.e. all of those who participated in thecity-wide testing, which evidently excludes a number of absentees and all those in special educational divisions (the blind, deaf, retarded, etc.). In addition, some graduates of the January and June of 1934 and the January of 1936 eighth grade classes were included.

The IQ and achievement test scores of most of the students were garnered from school board records. Other scores were found on the perman records of student who were selected from complete class rolls. No subjects were used unless IQ's were available for the whole class.

From Norwalk, which had a population of in 193 , a group was selected from the class registers of all 9th graders in the year 1935-36. Since these students werein the last year of junior high, the list selects subjects before the natural break where many students left school permanently in order to go to work, i.e. before the summer between junior high and high school. Intelligence quotient scores were found for 245 of the 317 students in this class. The 72 students for whom no IQ score was found either did not take the test when the others did, had their records lost, were not yet in the city, or had moved out before the examination.

Waterbury had a population of 104,900 ~~and three high schools in~~ 1935. One of ~~these~~ its 3 high schools, Crosby, was an academic high school. The Waterbury portion of the sample was taken from this school. Test scores were found for of the males who are listed as having at one time or another been in the class which was to graduate in 1939. Again, those for whom scores were not found were apparently either in a different school system, absent when the test was administered, or their test scores were not transcribed onto their permanent record cards. The Waterbury students are not a representative sample of all students in the school system, as their interest in college and relatively high IQ scores indicate. This group brings into the sample a larger number of individuals with high IQ's who are not in the highest social class.

Several different intelligence and achievement tests were used in the various cities. Hartford used the Otis Self-Administered Intermediate intelligence test and the Metropolitan Achievement Tests Advanced Battery --Partial; Norwalk used the Kuhlman-Anderson IQ test and the Unit Scale of Attainment achievement test; Waterbury apparently used the National intelligence test[2] and recorded no achievement test score; and, finally, all of the private schools used the Otis Self-Administered Advanced intelligenced tests. [illegible]. Since IQ tests use different standard deviations, grades other than 100 are not directly comperable. The scores were therefore adjusted so as to make them all have a common standard deviation of 11.85 IQ points, the standard deviation of the Otis tests. The literature on the versions of the IQ tests that were used in the 1930's is rather sparse with regard to the question of standard deviations. I have pieced together estimates of the standard deviations of each of the tests from a variety of sources.[3] The National scores were brought closer to 100 by 11.85/19.5 times the deviation from 100 and the Kuhlman-Anderson by 11.85/12.0.[4]

Other information in addition to IQ data was found for various subgroups of the sample. For example, the Norwalk students' record cards include information on parents' education, parents' names, student's grade average, whether the student left school, and achievement test scores. Some of the Hartford students' cards have parent's occupation listed as well as whether or not, how often, and what foreign language was spoken at home. The year and month, if not the day, of birth was indicated for all the students in the sample.

The tracing procedure was simple, although tedious and time-consuming. City directories were consulted for Norwalk, Hartford, and Waterbury as well as for several of their surrounding communities.[5] The student's name, together with each of his parents' names, was checked. If only the father's name was available, and no listing was found for him, all the women's names were checked to see if the mother might be listed as the widow of the father. All addresses under a given name were recorded. In addition to the directory check, high school class reunion records were consulted for each of the cities. In this way many people who had moved from the area in which they went to school were located. A list of students to be included in the study was also sent to each of the private schools. These lists were checked agains alumni records and the available addresses were kindly furnished by the schools.

In this manner an address for a person of the same name or a definite recording of the person's death was found for 70 percent of all the names for whom IQ scores were available. For an additional nine percent, an address or addresses were found for a person with the name of the individual's parent or guardian. Questionnaires were sent to each address recorded. This meat that 21 percent, 381 persons, definitley never received a questionnaire. Whether the respondent was indeed the same person that was in the eighth or ninth grade in the late 1930's could easily be determined by matching birth dates. See Table for a complete breakdown of the addresses found.

INSERT A

THE RESPONSE

The responses amongst the private and public school groups were 362 in number. There was a much higher response rate from private school students than from public school students even when the higher percentage of addresses available for the former group is considered. There is a slight, statistically significant, upward bias in the IQ scores of those who answered, about two IQ points for both groups.[1] The standard deviation of each group of respondents is similar to its source group. Of the original group 21 percent furnished usable questionnaires. Thirty five percent of those for whom there is no information that they did not receive a questionnaire (I was able to find an address for either a person with the same name or the name of a perent and the questionnaire was not returned from the post office) either responded or were reported to be dead.

TABLE ___

	Original	Group					
[illegible]	Hartford	Norwalk	Waterbury	Total Public	Private Schools	Answers Public	Private
[illegible]82	111	17	1	129	5	8	2
82-93	264	59	35	358	6	53	0
94-105	382	75	68	525	45	81	14
106-117	316	63	51	430	73	104	26
118&+	96	31	57	184	72	35	39
TOTAL	1169	245	212	1585	201	281	81

accompanying footnote:

1. Private school students: $\overline{x}$ = 112:80, =13.04; respondents $\overline{x}$ = 114.59, = 14.03; Public school students: $\overline{x}$ = 100.35, = 13,74; respondents: $\overline{x}$ = 103.55, = 13.10.

In a study of Time magazine subscribers whose last names begin with the letters "Fa," Lazarsfeld and Franzen observed, "The evidence indicates that answers obtained through a mail questionnaire are appreciably more informative -- and therefore more satisfactory -- than answers obtained by an interview.... On questions that involve a degree of activity, the mail answers are more qualified ('some' high school or 'some' college instead of 'completed.')"[10] They found that 17 percent more refused to answer income questions in person than by mail, and that high income was more often divulged by mail than in person. These results were gathered by interviewing in person both people who had answered the original questionnaire and people who had not done so.

There are several studies which cast doubt upon the validity of income statistics for individuals from interviews. Summers analyzed re-interview data generated by the Survey Research center of the University of Michigan in their Survey of Consumer Finance.[11] The same group of people were interviewed in 1951 and 1952. They were asked in both years what their income was for the previous year and the year before that. the ratio $\frac{\text{1952 income}}{\text{1951 income}}$ was computed from the figures given for the two years in 1952 (called the "memory" ratio by Summers) and again using the 1952 figure from that year's interview and the 1951 figure from the 1951 interview (called the "correct" ratio). Then, using the intervals below, Summers set up a matrix with the interval from the "Memory" Ratio as the row designation and the "Correct" Ratio as the column designation.

When this was done, only 52 percent were in the diagonal cells, that is, were in the same interval for both their memory and the "Correct" answers. But the reliable answers (those on the diagonal) seem to be randomly distributed and they could find no demographic group for which as many as 60 percent were reliable. When the hypothesis that the reliable respondants were a random selection was tested, it was found to be true with "two minor qualifications...:[the reliable] spending unit heads are somewhat older and better educated than the unreliable ones."[13] Since the interviewers were not required to speak to the same person at both times, some of the incongrueties may be accounted for by there being different members of the family responding in some of the cases,[14 note] ~~(see the Sirken study)~~, but this goes only a short way in explaining the large number of units who were not in the same interval by both measures.

Sirken, Maynes, and Frechtling found that in fewer than 63 percent of the cases did a person interviewed in August or September give income information which put him in the same income class as he gave in January or February when interviewed for a different study.[15] The income classes used were $100 wide from zero to $5000, $2,500 wide from $5,000 to $10,000, and finally an open-ended category from $10,000 up. The two surveys compared were the Survey of Consumer Finance and the

Census Quality Check. In comparison between 1950 income tax returns and the Census data for the same people, Miller and Paley found only 45 percent to be in the same income category on both responses when intervals of $500 up to $5,000, $1,000 up to $7,000, a $3,000 and then an open-ended interval of $10,000 and up were used.[16] They also stated that the variations in response appear to be random.[17] ¶While each of these studies is of a different group of people and none of them uses the same questionnaire for the original and the comparative data, the evidence is weighty in support of the proposition that income data is not extremely exact. That there does not seem to be any particular bias as to what sort of person answers most reliably is, however, encouraging, since this means that no known biases are introduced by using the income data at face value. If one assumes that the unreliability shown above is due to poor or hasty memory, my study also has the compensation that any errors on the income statements from the four different years might tend to cancel each other out for a given individual.

Second, As a test of the reliability of my own data, I compared answers to some of the questions on the questionnaire to information on the school records dating back to the thirties. For small subgroups of the sample there is information to test crudely the reliability of five answers. The five questions which can be checked are father's occupation, frequency of language other than English spoken at home, father's and mother's educations, subject's grades in school, and the subject's education. The evidence will be presented in that order.

There was occupational data for the father on the school record cards of 30 subjects who responded to the questionnaire. Thirteen of them had a response on the questionnaire which was exactly the same as that on the records from the thirties. For another 12 the response was essentially the same, but not idenotical. For the remaining five, either there was a change in occupation or one of the answers was inaccurate (e.g. "mechanic" on the records and "laborer" on the questionnaire). In only one case would the difference in father's occupation, when combined with his education, lead to his placement in different social classes.[18] The answers correspond remarkably considering the vast difference between the time, place, circumstance, and author of the two records.

The school records for 16 respondents had information on whether o not a foreign language was spoken in the home. The possible responses on the records were "Never," "Part Time," and "Always." The questionnaire asked whether "any languages other than English was spoken at home by your parents?" and, if yes, whether they were used "Exclusively," "Often," or "Seldom." The only answers exactly comperable are "Never" on the records to "No" to the first part of the questionnaire question and the "Always" to "Exclusively." Three of the 16 were of this nature. Two could be definitely determined to be contradictory (e.g. "Never" on the records and "Often" on the questionnaire). The other 11 are ambiguous due to the larger number of categories allowed on the questionnaire. In this case evidence on the agreement of the records is mixed, partially due to the lack of comparability of the possible answers and partly because the extent to which foreign languages were spoken could easily change over time.

Educational data is available for comparison for 27 fathers and 24 mothers of the respondents. Again the possible responses are not exactly comparable. The record cards have listings which include such answers as: "High School," "Junior High," "7," "11," "High School Graduate," and "Fifth Form, France." The questionnaire asked for years of school completed through graduate and professional school for the father and through the twelfth grade for the mother. With the groupings that are used for the educational factor in determining father's social class in the Hollingshead Index, 16 of the 27 fathers and 16 of the 24 mothers are in the same educational category on both records. An additional eleven fathers and seven mothers are within one category, while four fathers and one mother are two categories higher on the school records and one father is three categories higher on the school records. The inconsistencies were more often in the direction of having the questionnaire response being lower than that on the records than vice-versa. The majority then, are in the same category on both records. A sizeable minority (19 of 51) are different. Most of them are at very low educational levels, using either record. Confusion or poor recollection about parents' educations evidently exists. This may be due to repression of the knowledge or to ambiguity as to the number of grades actually completed. Such ambiguity could be caused by night school courses or partially finished years of schooling.

In conclusion, the evidence suggests that the answers here are no more than fairly reliable.

The average numerical grade in junior high compared to the letter grade they "Mostly" had in "Grammar School (1-8)" is another rather unsatisfactory test for accuracy. Of 35 cases, 16 were in the same range (90-100 = A; 80-89 = B; etc.). The questionnaire figure was higher in 16 cases and lower in the remaining 13 cases. This test is very weak, since we are comparing grades 1-8 to grades 7-9, and after a lapse of 25 years at that. Remembering grades in the first few years of school is indeed a stringent test for a 45 year old man. Therefore, little credence can be given to this test, one way or the other.

Finally, there is information for some of the students on whether they graduated from high school or left before graduation. While the graduated information is accurate, the "left school" does not necessarily mean that the student did not finish high school, since he may have returned to school at some later time. Of those that responded, 109 are known to have graduated. In each of these cases the response to the questionnaire was that they had graduated. There are 20 for whom there is a recording of the student' having left school. Of these, seven indicated that they finished high school and 13 that they did not. Of these seven possibly inconsistent answers, three assert that they went not only to college but also to graduate school. One states that he went to night school after the war. One admits to having received mostly C's in high school, one to mostly D's in high school, but said he had some trade school, and the last claims two years of radio and electronics training after high school. In other words, each of the seven has answered other questions in such a way as to make his answer, which could seem to be an inconsistency, in fact the truth. Therefore, the answers to the education question seem to be very reliable to this observer.

Footnotes -- Section 2

1. Females were excluded for two reasons: their participation in the labor force is often sporadic and is not a high proportion of the group at any time; also, women are very difficult to trace over time, since their names change when they marry. The latter was probably the decisive reason for their exclusion because once the problem of handling labor force participation was solved, very interesting results would undoubtedly be achieved.
1a. IQ as a measuring device for inherent ability has had a great deal of criticism in the last few years on at least two scores. First, there are many sorts of ability and one score, at best, cannot give a full picture of an individual's abilities in all fields. Second, most, if not all, IQ tests can be successfully attacked as not being devoid of cultural bias. Those children who grow up in homes where verbal qualities are stressed and a wide range of information passes through the air do score higher than children who do not have these advantages.

In spite of these criticisms IQ is the best measure of general ability available for large groups of people. Even if there is a cultural bias, IQ serves the purpose of this study, because the desired variable is ability in the form of its effect on earnings potential. In addition, there is a social class variable included so that each individual's IQ will be compared, in eggect to the IQ of those in the same social class. For a further discussion, see Hunt's dissertation, Chapter 1.
1b.

2. After questioning the director of Special Services, who in turn queried retired and present administrators of the school system, it could not be definitely confirmed which test had been used. The National was given in Waterbury in the early 1940's and it is assumed that this was the same test used earlier.
3.

4. That is, where IQ* = adjusted IQ, if original IQ is greater than 100, IQ* - .9875 (IQ - 100) + loo for Norwalk and IQ* - .6077(IQ 100) + 100 for Waterbury; if IQ is less than 100, IQ* = 100 - .9875(100 - IQ) for Norwalk and IQ* = 100 - .6077(100 - IQ) for Waterbury.
5.

6. See Appendix for the full questionnaire.
7. See West, Appendix for the Time Survey questionnaire;

8.

9. Some questionnaires were returned unanswered with comments as to the excessive length of the questionnaire in spite of all efforts to keep it as short as possible.
10. Paul F. Lazarsfeld and Raymond Franzen, "The Validity of Mail Questionnaires in Upper income Groups," Time Magazine Research Report #950 (May 15, 1946), p.6.

Footnotes Section 2 p.2

11. Robert Summers, *An Econometric Investigation of the Size Distribution of Lifetime Average Annual Income* (Stanford: issued by the Stanford University Department of Economics, March, 1956).
12. ibid., pp. 32-33.
13. ibid., p. 44.
14. See M.G. Sirken, E.S. Maynes and J.A. Frechtling, "The Survey of Consumer Finances and the Census Quality Check," in *An Appraisal of the 1950 Census Income Data*, Vol. 23 of *Studies in Income and Wealth* (Princeton: Princeton University Press, National Bureau of Economic Research, 1958), pp. 127-169.
15. ibid., p. 142.
16. Herman P. Miller and Leon R. Paley, "Income Reported in the 1950 Census and on Income Tax Returns," in *An Appraisal of the 1950 Census Income Data*, Vol. 23 of *Studies in Income and Wealth* (Princeton: Princeton University Press, N.B.E.R., 1958), pp. 179-201. See pp. 197-198.
17. ibid., pp. 199-200
18. The records showed this man to be a plumber and the questionnaire response was "accountant." Since the questionnaire directs the responder to answer in terms of the "People who raised you, whether or not they were actually your parents," this could be t explanation for the difference in some of the responses, although this particular individual did check "Father" and "Mother" for the answer to "Who raised you?".

There are many problems involved in trying to determine the effect of education earnings, which are due neither to people's diversity, the difficulties in determining the proper functional relationship between the variables, nor even to gathering adequate data, but rather arise from the necessity of quantifying and defining the variables themselves. So that the reader can better judge the results of this study, a discussion of how some of these problems were dealt with is necessary.

Earnings itself is one of the most troublesome variables. This is true whether the individual is self-employed or hires out his labor. The major problem when dealing with individuals who are self-employed is how to separate returns to their labor from returns to the capital that they have invested in their business. One would not want to treat two men the same if both had earnings of $10,000, but one owned a $1,000,000 factory and the other owned $5,000 worth of plumbing equipment and parts. Inherent in this problem is the question of determining how much capital is actually involved. Does one, for example, include "good will" as part of capital or merely reproducible goods? This is especially critical in considering the capital involved in a professional man's (doctor's, lawyer's, accountant's, etc.) business. As an alternative one may opt for using the amount invested as a measure of capital. In this case, retained earnings would have to be treated as part of earnings and also as part of investment. This is probably the best theoretical solution but has great practical difficulties, since people with small businesses often do not keep adequate records for such calculations. If direct investment plus retained earnings is used as a measure of capital, there is a problem of appreciation and depreciation, both from overall price changes and from fluctuations in particular markets.[1]

For this study, the data available for use on this question consisted of answers to questions on the profit of a self-owned business, its worth, the profit left in, and the profit or wages taken out of the business.[2] . Gross earnings was assumed to be equal to the wages, salary, and profits taken out, plus the profit left in the business.

Since the only figure available, on which to base the portion of gross earnings due to capital was the answer to the very general question mentioned above, there is no way to treat the various problems of how best to define the amount of capital invested in the business. A very detailed history of each business would probably provide the best set of data to use for a more adequate estimate (if enough people would answer such an extensive query) and a second best method would be to ask the single question on the worth of the business, which was used in this study, prefaced, however, by several statements of principles explaining how they should derive their estimate

After the size of the capital involved is decided, there is still the difficult question of what interest rate to use in determining the earnings which can be ascribed to the capital invested. Several different interest rates have been used in similar problems in the literature.[3] Eight percent is the arbitrary choice for this study. Hence, eight percent of the value of the business was deducted from gross earnings to determine earnings from labor for self-employed men. A test of the sensitiveness of the size of adjusted earnings to the interest rate used shows

In comparing the earnings of individuals, the earnings rate is the best unit of comparison.[4] Other difficulties are associated with this type of calculations. What proportion of the time spent on the road by a traveling salesman should be counted as hours worked? Should the hours spent in a charity ward by a doctor be included as part of his working day? How should the work~~ed~~ performed by a spouse in a family business be treated? For this survey, answers to the questions about the number of hours per week and weeks per year usually worked were taken at face value, since no evidence was available with which to derive some other estimate or adjustment. For men who were self-employed and whose wives worked in the business, $2.00 per hour worked was deducted from gross earnings since the gross earnings were defined for the man and his wife.

Once a figure for earnings per unit of time worked is established, the ugly problem of how to treat what has become widely known as "fringe benefits" springs to the fore. The amount of time contractually paid for, but which is not actually worked, varies widely. Such time includes paid vacations, paid holidays, coffee breaks, time for medical services, sick leaves, and numerous others. In the United States as a whole, these have a value of

.[5]

Other fringe benefits include pensions, health insurance, accident insurance, bonuses, premium pay, legally required insureances, /etc. This study has data on paid holidays, vacations and sick leave, but not everyone answered each of these questions and some of the answers are indefinite.[6] Surely, if adequate data were available, the equivalent of the paid time not worked should be added to earnings. The cost of other benefits, I would argue, should be included at the rate of their cost to the employer. Others argue that since the employee does not have a choice as to whether or not he will "purchase" such benefits, they do not have full value to him. Therefore, they conclude, these should not be included at more than 75 (or some other figure) percent of the value.[7] Since these benefits are often created by the collective bargaining process just as wages are, it seems arbitrary to conclude that one part(wages) is full value and another (fringe benefits) is only part value. Moreover, those who argue in this way have a difficult time trying to defend any specific discount figure chosen.

How to treat fringe benefits for self-employed persons creates a further difficulty. What is the meaning of "no" paid vacations if the individual only worked 48 weeks? Again, I was forced to take the answers at face value. Since I am computing earnings per hour worked, this is self-correcting in the case of the self employed individual as his earnings are merely spread over fewer weeks.

In this study, then, no measure of fringe benefits other than pay for time not worked is used, and even this is not used in all cases due to the incompleteness of the data. Ideally earnings per hour would take into account all fringe benefits and periods of unemployment. To determine lifetime earnings, a complete history of employment, vacations, holidays, unemployment, periods of ill health and whether they were paid for, capital invested by those who are self-employed, and length of time worked would be used. I approach this ideal as best I can, considering people's memories and their willingness to spend time answering questionnaires.

Since the primary interest of this study is the effect of education on earnings, education must also be quantified. Education is a quite heterogeneous concept. One can measure it in several, non-exclusive units: hours, days, years, dollars of expenditure, years of specific types, degrees and diplomas received, information learned, education of parents, number of courses taken, etc.. Each of these has relevance and each has probably been used at one time or another.[8] In this study, several measures are used. Years of formal schooling, months of training either on the job, in trade or technical schools, or by the military; expenditure on formal education; and education in the home as represented by parents' education. Expenditures on education is a proxy for quality of education. The idea of time units of education being homogeneous is one of the strong simplifying assumptions which most authors in this area of investigation to date have felt impelled to make, due to lack of other data.[9] My study will try to eliminate this assumption by differentiating students through measures of ability and background and by differentiating education through measures of expenditure.

Various types of training are not differentiated, nor are their costs considered in this study. It is assumed, by default, that they are equal in value and cost. On the job training has the cost of a lower salary while the training is occuring as does military training (lower than that for civilian employment). Formal courses in technical or business schools are often undertaken while working full time, so the earnings foregone may be less than for the above types of training, but such education has often a direct cost which offsets this.[10] For those who undertook full-time training at private institutions, this assumption of homogeneity does understate its cost relative to other training costs.

Education which is achieved through informal means such as one's own reading, discussion, or family influences is more difficult to quantify.[11] It is, nevertheless, extremely important.[12] That this is being fully realized today can be seen in the current emphasis on the use of early formal schooling as a weapon against the self-perpetuatiing "cultural poverty" of many of those who have very low incomes. Two factors, parents' education and father's occupation, are used in this study to partially represent learning in the home. These also affect income directly through the occupational opportunities which they may bestow upon the young man -- assistance in finding a first job or capital to start a business, for example. This latter is indeed an important matter.[13]

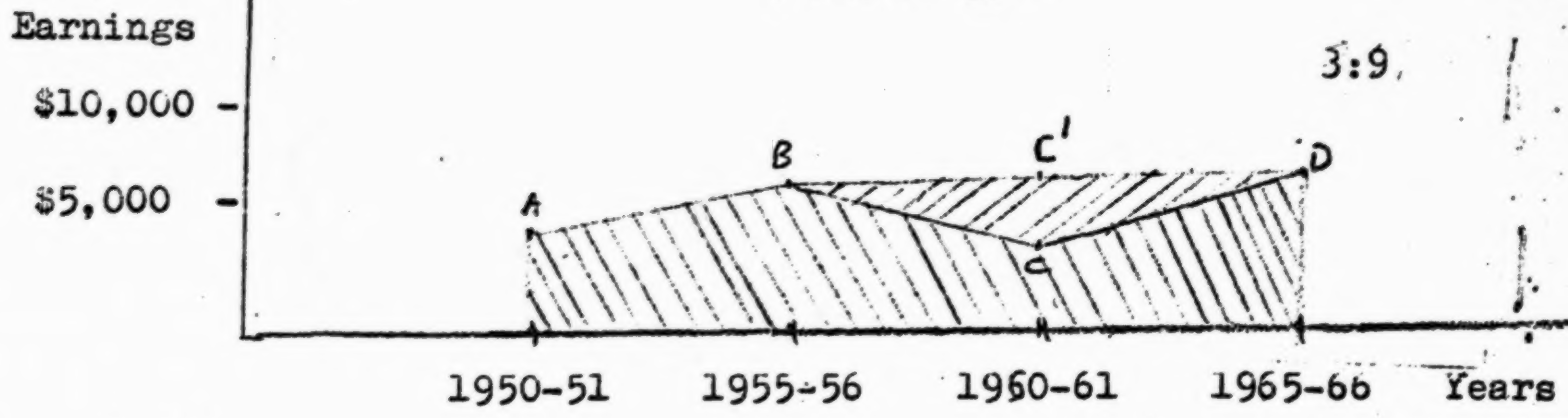
When correlating education with lifetime income, consideration should be given to the timing of that education. One cannot expect a college degree earned at the age of 40 to have the same effect on lifetime earnings as one received at the age of 20, since the latter individual has 20 extra years in which to derive the benefits of that education. Timing would even affect the relationship between education and income in any one specific year. A lawyer can be expected to earn more, ceteris peribus, ten years rather than one year after earning his degree. Since no information was gathered in this study on the time sequence of education, this problem is ignored here. I originally hoped to find a group who would have potentially finished college before World War II in order to minimize the probability of widely divergent time paths of education, but given the geographic restriction, it was impossible to find such a group for whom IQ test scores were available.

The effect of occupational choice on earnings has caused great troubles for other studies. It is obvious that occupational choice has a bearing on the relationship between education and earnings. One has only to think of the minimal earnings and extensive education of most clergymen to see this. While trying to correct for the effect of individual occupational preference, many over-compensate by attributing to occupational choice differences in earnings which rightfully belong to education.[14] This type of error is one of the major faults in several of the case studies discussed above.[15] Inclusion of a variable for occupation or exclusion of those in certain occupations would bias the estimates of the average effect of education on earnings. In order to avoid this sort of error, occupation is left out entirely in this study.[16]

The final, but certainly not the least important problem is how to determine lifetime earnings. Again, even the ideal is not easy to define. At what age should the record of earnings be begun? Should "earnings" from mowing the lawn in front of the family house at the age of ten be counted? Some have picked 25 years as the age to begin this calculation, implicitly assming that formal education has been completed by that age.[17] Others have used 14 years of age for a starting point, as has been pointed out above. [18] The blending of full-time school into part-time work by many individuals makes a cutoff point for the "end of school" difficult to use empirically. The difficulties of data collection add considerably to this problem. Only a longitudinal study with annual reports from a pre- or early-teen age to death would achieve full data.[19]

This survey has earnings figures for four years over a 16 year span (1950,1955,1960, and 1965). The quality of these figures probably decreases somewhat in relation to the length of time between the earnings and the survey.[20] The assumption that the actual earnings of these individuals changed at a steady rate between each observation for this period, yields a total equal to the area under the line connecting the figures (ABCD in Figure) for the four years.21

FIGURE 3A

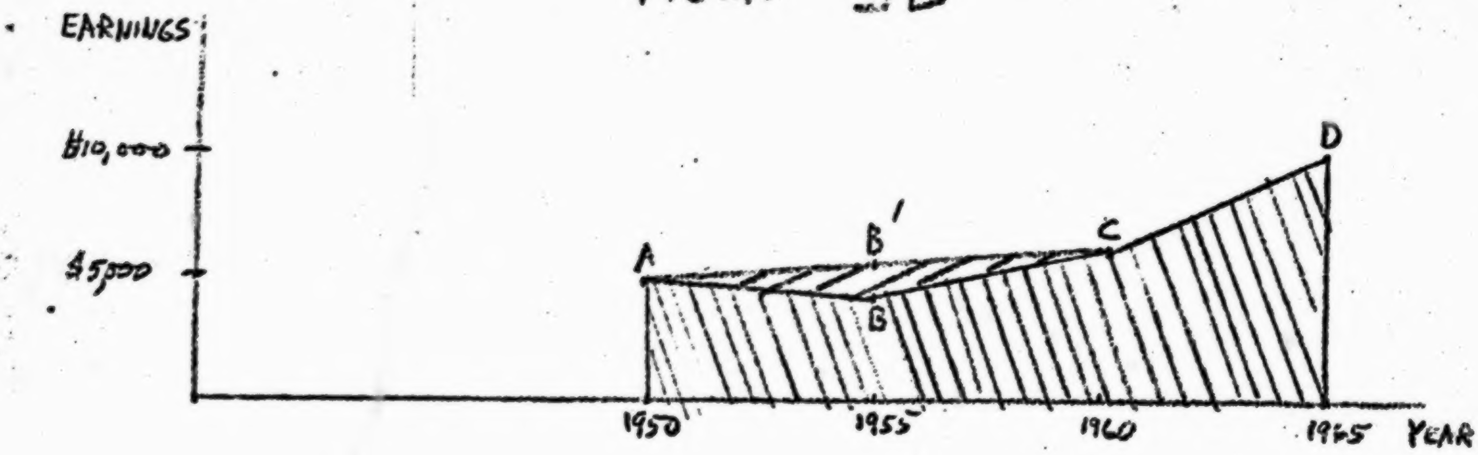


This is a very rough estimate of the earnings of individuals, but less likely to introduce error than any other assumption.

In a few cases income in one of the middle years is below either of its neighboring years (for example, 1955 earnings are lower than 1950 or 1960 earnings). It would appear that this is a temporary situation for the individual -- a "bad" year -- rather than an indication of a steady decrease followed by a steady increase for the ten year period. Since each of the four observations available is so heavily weighted, it seemed that in such cases earnings would be better estimated by using some modification of the steady change assumption. It was decided to use a figure half way between that derived by ignoring the low number entirely and that derived by making no correction. Thus, half the area of the triangle ABC in Figure 3A was included with the area under ABCD as earnings (or half the area of BCD in Figure 3B)[22]

Having an estimate of each individual's earnings for a 16 year period is not sufficient to determine the lifetime effect on earnings which is to be derived from additional education, although it is a larger proportion of actual lifetime earnings of individuals than anyone else has achieved to date. At this point, it is worth while to make some much stronger assumptions about the earnings of my sample for their productive years other than those between 1950 and 1965.

FIGURE 3B



There are two periods to be estimated, the years between 1934 or 1935, when the individuals were selected and 1949 and those between 1965 and retirement. For the period from 1935 to 1950 an estimate of constant dollar earnings[23] was made based on the following data: the length and dates of military service, rank when leaving the military, years of education, earnings in 1950 and any comments about this early period which were volunteered by those surveyed.[24] On the basis of his questionnaire, each respondent was regarded as either in school, in the military or at work in each year during this interval. It was assumed that all education was contiguous in time unless military service intervened or it was specified that this was not the case. Earnings of those in school were assumed to be zero during high school, 12.5 percent of the average earnings ofproduction workers for the given year during college, and 25 percent during professional or graduate school.[25]

For the duration of military service, earnings were assumed to be equal to the base pay in the specific years served for the highest rank achieved by each individual. The bonus for overseas duty was added for all personnel during the years 1942 through 1946. The allotment for housing and subsistence (assuming dependents, where this was a consideration) was added as this was assumed to equal the value of these services when actually supplied by the military. Using the highest rank achieved overstates earnings in many cases, but the exclusion of such bonuses as 50 percent flight pay leads to underestimates in some cases, thereby somewhat balancing this out. Since there was no way of knowing at what rank a man entered or how fast he was promoted, this seemed to be the simplest assumption.

The estimate of all earnings for non-military employment was based on 1950 earnings for the individual and gross average weekly earnings of production workers for each year in this period.[26] The ratio of a subject's 1950 earnings to average earnings for production workers in 1950 was applied as an index to the average earnings for production workers for each year worked in the 1935-1949 period. For the years before 1942, the earnings were reduced to account for the high unemployment rates of those years.

Since the unemployment rate for teenagers has always been significantly higher than for the general population, the global rate would not reflect the probability of unemployment adequately. Unfortunately, no source of unemployment by age for this early period seems to be available. Therefore the total unemployment rate for males 14 and over for each of these years was increased by the average of the ratios of the unemployment rates for 14-19 year old males to the rate for all males for the years 1948,1949, and 1954. These years were chosen for their fairly high unemployment rates.[27] The group surveyed was no longer teenage by by 1942 and the unemployment rates had decreased to such an extent that no reduction was made for possible unemployment for the calendar years 1942-49.[28]

Footnotes -- Section 2

1. The question of the value in 1965 of a coal mine purchased for $100,000 in 1935 would be an example of both these problems.
2. See appendix , p.) [illegible]
3. Becker, p. ; Hunt, p. ; Miller, p. ..
4. See Morgan, et al. for a full discussion of the advantages of hourly earnings over total earnings.
5.

6. For example, answers such as "All" or "All legal" to the questionsof how many paid holidays they are allowed. Surely
7.

8. Schultz uses days and hours in his article "Capital Formation by Education"; see table for an extensive listing of how other authors measure education.
9. One exception has been the work of Shane Hunt in his essay and dissertation discussed above and his forthcoming "Quality Variation and the Returns to Education" for the Symposium on the Economics of Quality in Education at the American University. See also Allan M. Cartter's work for discussions of the variation in quality, even though it is not used in the same sort of context, e.g. "Qualitative Aspect of Southern University Education", The Southern Economic Journal, 32 (July 1965, part 2), pp.39-69.
10. This was more often the case in the period when those in this study were being educated than is now the case due to the vast growth in public junior colleges and adult education facilities. Offsetting this is the availability to many of those in this stydy of educational subsidy under the "GI Bill of Rights", but the law recently passed prividng for a peace-time or cold war "GI Bill of Rights" will swing the availability of free education of this type back in favor of the generation following the one used in this study. See Becker, chapters II and III, for one theoretical discussion of such training and its effect on income and expenditures.

Check

11. See Fritz Machlup, The Production and Distribution of Knowledge in the United States (Princeton: Princeton University Press, 1962), for a valient attempt to quantify on an appregate level all the resources used in the production and distribution of knowledge. This does not help, however, in the immediate question of quantifying individuals' education through informal means.
12. Marshall asserts: "The most valuable of all capital is that invested in human beings; and of that capital the most precious part is the result of the care and influence of the mother..."p. 562.
13. See p. above.
14. Becker, p.86 including fn. 25.
15. See p. and Table .
16. Occupation comes in tangentially through the difference in the cost of various sorts of education. An attempt is made to take these cost variations into account when quantifying educational expenditures.
17. This is used by Miller, . The fact that Ph.D.'s average years and M.D.'s years of age at completion of their studies shows that this assumption is not universally true. See

for data on age at receipt of these degrees

Appendix E

Reading List

Economics 550
Human Resources and Economic Growth: Investing in People

University of Wisconsin
Department of Economics

Professor Weisbrod
Spring 1965

Economics 550

Human Resources and Economic Growth: Investing in People

The following is a partial list of readings and topics to be covered. Additions to the list will be distributed later. Also, attached is a list of questions you should be attempting to answer throughout the semester.

I. Sources of economic growth

Bowen, W. "Investments in Human Capital and Economic Growth," mimeographed.
Solow, R., "Technical Change and the Aggregate Production Function," *REStat.*, Aug. 1957, 312-20.
Kendrick, J. Productivity Trends in the U.S., pp. xxxv-lii, 3-41, 59-67, 78-86, 104-110.
Denison, E., *The Sources of Economic Growth in the U.S.*, Chps. 1-3, 13-24. (hereinafter cited as Denison).
Schultz, T., *J.P.E. Supplement*, (October, 1962.)

II. Investment in Human Capital -- Theory and Concepts

Schultz, T., "Investment in Human Capital," *AER*, March 1961, *AER*, March 1962.
Weisbrod, B., "Value of Human Capital." *JPE*, October 1961.
Becker, G., *Human Capital*, Ch's. I, II, III, or Becker, *JPE Supplement*.

III. "Public goods" theory.

Musgrave, R., *Theory of Public Finance*. Ch. 1, pp. 3-22, Ch. 3, 4, 6 (pp. 132-33), 7 (pp. 133-40), Nov., 1954, pp. 387-89.
Samuelson, P., "Pure Theory of Public Expenditure," *R.E.Stat.*, (see also Samuelson. "Diagrammatic Exposition of a Pure Theory of Public Expenditures," *REStat.*, Nov., 1955, pp. 350-56.)

IV. Education as investment

Schultz, T., *The Economic Value of Education*, Ch's III, IV.
Becker, G., *Human Capital*, Ch's. IV-VIII.
Eckaus, R., "Education and Economic Growth," Ch. 8 in *Economics of Higher Education* (Mushkin, editor),
Denison, E., Ch. 7, "Education and Growth".
________, *JPE Supplement*.
Hansen, W. L., "Total and Private Rates of Return to Investment in Schooling," *JPE*, April 1963, pp. 128-40.
Weisbrod, B., "Costs and Benefits of Preventing High School Dropouts," *Public Investment Expenditures*, Brookings Institution (hereinafter cited as Brookings); and Comments by H. P. Miller, Summary remarks by Weisbrod.
Goode, R., "Educational Expenditures and the Income Tax," in *Economics of Higher Education*. (See also Goode, *The Individual Income Tax*, 1964, pp. 82-94.)
Machlup, F., *The Production and Distribution of Knowledge*, Ch. on formal schooling. (At least look over the remainder of the book).

Bowman, M., "...the contribution of 'Eds' to National Economic Growth", JPE, October 1964.

Friedman, M., Chapter in Solo (ed.) Economics and the Public Interest

Supplementary (not required) but recommended.

Schultz, T., "Education and Economic Growth," in Social Forces Influencing American Education.

Morgan, J., et.al. Income and Welfare in the U.S., especially ch's 23-25.

Bowen, W., Economic Aspects of Education.

Vaizey, J., The Economics of Education.

Weisbrod, B., JPE Supplement.

V. Information and on-the-job training, as investments

Stigler, G., "The Economics of Information," JPE, June 1961.

Mincer, J., JPE Supplement.

Economics 550
Human Resources and Economic Growth

Spring 1965

Professor Weisbrod

Additional Reading List

VI. Migration

Sjaastad, L., JPE Supplement

Weisbrod, B., "Geographical Spillover Effects and the Allocation of Resources to Education," in Margolis, editor, Urban Public Expenditures.

VII. Health and Safety as Investments

Mushkin, S. and Frank Collings, "Economic Costs of Disease and Injury," Public Health Reports, Vol. 74 (September 1959), pp. 795-809.

Arrow, K., "Uncertainty and the Welfare Economics of Medical Care," AER, Vol. 53 (Dec. 1963), pp. 941-973.

Mushkin, S., JPE Supplement

Weisbrod, B., Economics of Public Health, Chapters 2, 3, 4, 9, and skim 7 and 8.

Lunenberg, C., "How Shall We Measure Economic Benefits from Public Health Services," in U. S. Public Health Service, Economic Benefits from Public Health Services, pp. 1-12.

Smoking and Health, U. S. Public Health Service, Surgeon General's Report, 1964, pp. 175-189 (Evaluation of the Association between Smoking + Lung Cancer.)

Reynolds, D., "The Cost of Road Accidents," Journal of the Royal Statistical Society, Vol. 119 (1956), pp. 393-408.

Scitovsky, A., "An Index of the Cost of Medical Care . . . " Economics of Health and Medical Care, pp. 128-143.

Klarman, H., "Economics of Medical Research," mimeographed.

__________, "Measuring the Benefits of a Health Program--the Control of Syphilis," Government Investment Expenditures (Brookings Institution, 1965)

J. Enoch Powell, "Health and Wealth," Proceedings of the Royal Society of Medicine, Vol. 35, (Jan. 1962), pp. 1-6.

U. S. Public Health Service, "Long Range Planning for and Analysis of Medical Research and Training Needs," mimeographed, 9 pages, 1964.

Hansen, W. L., "Shortages and Investment in Health Manpower," in The Economics of Health and Medical Care, pp. 75-91.

Wiseman, J., "Cost-Benefit Analysis and Health Service Policy," Scottish Journal of Political Economy, Vol. 10 (Feb. 1963), pp. 128-145.

Rimlinger, G. and H. Steele, "An Economic Interpretation of the Spatial Distribution of Physicians . . .," SEJ, Vol. 30 (July 1963), pp. 1-12.

Supplementary:

Klarman, H., Economics of Health. (Surveys the field and contains an extensive bibliography.)

Fein, R., Economics of Mental Illness.

The Economics of Health and Medical Care, University of Michigan (a collection of papers on such subjects as: The Role of the Economist in the Health Services Industry, Demand, Costs, and Prices of Health Care, Investment in Health, etc.)

Economics 550
Human Resources & Economic Growth

Professor Weisbrod
Spring 1965

Questions for discussion and review

1. In what ways do each type of expenditure on human resources contribute to productivity and growth?

2. *How much* does each contribute? Are there interaction effects? How strong is the evidence?

3. Do private decisions lead to "optimal" levels and allocations of such "investment" expenditures? Why?

4. *Why*, if at all, is there a role for government involvement in these markets?

5. Do these expenditures involve both investment and consumption, and if so, do special problems of analysis arise?

6. Is the distinction between human capital and physical capital useful for purposes of analysis? for relating analysis to policy prescription? Why?

7. What are the implications of the human capital concept and the related empirical information for "traditional" economic theory, and for traditional economic *policy*?

8. What additional *data* are needed to improve analysis and policy-making with respect to human resources?

9. What *conceptual* issues confront the analysis of human resource markets? (That is, do we need more and better *theory* or simply more and better data? Is it clear in all cases precisely which data are needed?)

Appendix F

Written Comments of Discussants:

A. Winnick on Mark Blaug

J. L. Helder on Harry Johnson

D. DeVoretz on Thomas Fox

J. A. Wilson on Edward Denison

A. Winnick

Workshop on the Economics of Human Resources

Summary of Mark Blaug's Presentation

"Manpower Planning versus the Rate-of-Return Approach"
22 February 1966

I. Manpower Forecasting (M.F.) vs. Rate of Return (R.R.) Approach to the problems of (national) education.

A. Manpower Forecasting: The method is one which first, attempts to predict the levels of trained manpower that will be required to reach certain predetermined targets of economic growth etc, and then attempts to translate these manpower needs into requirements and programs to be enforced in the nation's educational system to meet these needs.

B. Rate of Return: This method attempts first to determine the future stream of costs and benefits that accrue to additional education (in this case) and to then determine that rate of return which will reduce (or discount) the two streams to a net present value of zero, i.e., P.V. of Benefits - P.V. of Costs = 0. The assumption is that those advocating this approach would enforce requirements and programs on the educational system that would exploit those areas of the educational system having the highest rate of returns (the use of the word "enforce" is, of course, stating both approaches in their extreme.)

C. Some Differences between MF & RR

1. MF does not concern itself with the cost of education or even with the benefits of it, per se; whereas, RR is critically concerned with the costs and benefits.
2. MF is much more policy-oriented than is RR.
3. MF "tells" how much and where to invest in order to get "needed" manpower, RR "tells" only where to invest in response to high RR.
4. To look at the pure or extreme view of those advocating MF or RR, one can consider the polar views each has of the world:

The Polar View of MF'ers — A world of perfect complimentarity

The Polar View of RR'ers — A world of perfect substitutability

The Polar View of MF'ers: Educational System	The Polar View of MF'ers: Production System	The Polar View of RR'ers: Educational System	The Polar View of RR'ers: Production System
Characterised by:	Characterised by:	Characterised by:	Characterised by:
1. Great (total) Inflexibility eg: a) fixed student-teacher ratios b) fixed plant capacity	1. Great inflexibility	1. Great Flexibility	1. Great flexibility
2. Students who are non-economic in choosing subject field i.e.: not influenced by prospects for future earnings or costs of education.	2. Perfectly inelastic demands for different classes of skilled & professional labor i.e.: No substitution possible between skills	2. Students react completely & immediately to changes in income and cost prospects	2. Perfectly elastic deman & perfect substitution of skills
3. Very early (age 11-15) placing of children in vocationally orientated "tracks" from which they can not switch.	3. Labor Markets are very imperfect.	3. Irrevocable vocational decisions are delayed as long as possible e.g. age 18-21	3. Competitive labor markets

5. Thus, M.F. sees a very inflexible and rigid world where there is as much as a 10-year lag (or required lead-time) on effecting changes in manpower; whereas, RR sees a very flexible world where the lag is only 2 to 4 years.

II. Blaug then indicated that most RR research has been done in U.S. and most MF research in U.K. and Europe. He feels this is not surprising since U.S. tends to be far more flexible then the U.K. in terms of the educational system and labor market characteristics indicated in C-4 above. Note the word "tends".

He then discussed the situation in the U.K. especially the rigidities in their educational system, for example:

1. the early placing of children in vocationally oriented tracks (with very limited ability to switch).

2. the history of excess demand for higher education not eliciting an increase in supply.
3. the artificial and imperfect distribution of the existing supply to the existing demand.

III. A. Blaug pointed out that in a "more" rigid world one paid a much higher price for wrong manpower forecasts since the market could not (or would not) adjust to correct mistakes; whereas, in a "more" flexible world the market would make the necessary adjustments.

B. In light of this higher cost for wrong forecasts, the "more" rigid countries should be the last to practice manpower forecasting, since by its very nature MF cannot be perfect. In fact, Blaug suggested that MF would most likely "always" be quite wrong due to the fact that we (economists, et.al.) cannot accurately:

1. Forecast technological change either in:
   a) broad terms ie: industry by industry, or
   b) specifically ie: factor by factor
   (That is we need to be able to predict the exact production function for each industry and this can not be done.)
2. Translate job requirements into exact educational requirements and programs.

IV. A. Blaug therefore advocates, that as an alternative to either MF or RR per se, that all nations should try to make their educational and productive systems more flexible by, for example:

1. Improved vocational advice to students.
2. Improved and expanded non-school training, that is, "on the job" training, industry on union sponsored training, etc.
3. Increased flexibility with the educational system through, for example, team-teaching, new devices (TV, etc.), more flexible plants.
4. Encouraging free choice by students of subject areas and allowing "switching" as long as possible.

B. He suggested that the above (IV-A) should be done in underdeveloped countries particularly, where consideration should also be given to sending more students abroad for their specialized training.

C. In general, he felt that manpower forecasting (as opposed to manpower planning) should not even be attempted in most countries. Nations should, instead, attempt to improve the automatic workings of the markets for education and for labor and the interrelations between them. He implied that if this were done, rate of return considerations by the participants of the two markets would insure the more or less automatic satisfying of changing manpower requirements.

Summary

of

Harry Johnson's

ECONOMICS OF THE BRAIN DRAIN

Prepared for Economics 968

by

John Lewis Melder

April 1, 1966

Considerable controversy has developed in the world -- and especially in England and Canada -- over the so-called "brain drain." Much of it, according to Johnson, is due to nationalistic feeling, and, to some extent, shoddy economic analysis.

Specifically, brain drain means the movement of people from one geographic area to another. And in the sense within which today's controversy is centered, it means movements across national boundaries. The term "brain drain" is, itself, a loaded one which indicates something "bad" results from the movement.

However, as Johnson point out, the move is not "bad" for those making it since they are doing it of their own choice, and, presumably, to take advantage of better opportunities. Johnson also objects to the brain drain concept at this level on the grounds that it defines implicitly a person's "worthwhileness" in therms of education.

He says those using this type of reasoning are trapped by feelings of nationalism. They think in aggregate instead of per capita terms, and, furthermore, are defining welfare economics in terms of geography instead of people.

In this context, maximizing living standards means maximizing them in relation to a particular geographic area. But this is not an economic view. There is nothing about national boundaries, he points out, which says they are perfect in an economic sense, e.g. they contain all that is necessary for progress. Thus, international specialization -- and flows of manpower across boundaries -- are inevitable.

From a historical point of view, Johnson notes that such movements always have occurred. And from a developmental point of view, they also have contributed to growth, he says.

Supporting the latter statement he cites a recent study by Kindelberger of contemporary labor movements in Europe. Kindelberger undertook the study to test two theories of growth: one claims that growth can be stimulated in a "deprived" area by intensive inflows of capital; the second posits that growth can be stimulated by using migration to arrive at the correct resource ration. Based on his study, Kindelberger claims the second theory best explained the recent growth in southern Europe, especially southern Italy, an area which had witnessed a large outflow of labor to the prosperous north. Kindelberger concluded the labor outflow induced a factor adjustment in the south which led to a more capital intensive mix.

Johnson says the brain drain syndrome found a fertile seedbed in England for two reasons: (1) the government set salaries instead of allowing market forces to work, and (2) in order to maintain some vestige of a "major power" status, the government engaged in huge, scientific projects, several of which were unfeasible. Against this background, the brain drain fears grew because many of the country's top researchers were leaving to take higher paying positions in other countries.

Johnson claims the brain drain proponents overlook several factors. One of the most obvious is that brain draining is a two-way street and countries such as Britain and Canada have overlooked the inflow of manpower into their countries. In both cases, he says, the inflow is significant and probably outweighs the outflow.

Secondly, he points out that education today extends several years beyond graduation and in many cases the so-called outflow is merely a stage in the educational process. Many of the young Ph.D.'s counted as lost in the brain drain leave to continue their education. Their return, however, often is not taken account of.

Thirdly, Johnson says that for many education is a tool with which one may escape poverty. For those who pay the bill, this may be a worthwhile expenditure, especially if the beneficiaries are their children. If there is a loss -- and Johnson admits there may be one in foregone taxing potential -- this can be recaptured by financing education through loans instead of grants. Even in this case, the loss is not so great as many brain drainers might suppose since the person who moves takes his children with him, thereby reducing the region's education load.

From a world welfare point of view, Johnson says that on a marginal basis there is no loss involved. If we assume a person's marginal productivity equals his wage, then if he moves to where his marginal productivity is greater, the world benefits.

Also, if the person emigrates his native land does not lose the benefits of his research since they will be easily available, and, furthermore, the benefits will be available at no cost to his own country because the host country will be financing the research.

Lastly, Johnson points out there may be some personal externalities associated with having great minds reside in their own country. In other words, there may be some specific benefits peculiar to each individual.

But this moves one into an area where identification and quantification are extremely difficult, and takes one a far distance from the original sense of loss to a nation generated by proponents of the brain drain.

Summary of Thomas Fox's Presentation and Comments

"The Production Function of Education"
16 February 1966

The central area of investigation of Fox's paper concerned the possible formulation of a production function for the school system of the city of Chicago. The author sketched out the hypothesized production function as follows:

(1) $Q = f(v_1 \ldots, v_n, s, t)$ where the v's represent a host of input variables, the s's school building age and the t's schoolteacher's ages.

Data on the variables was gathered for the Chicago school system for the early 1960's. The actual definition of the v inputs were many, but they included average class size, level of teachers education, socio-economic variables, enrollment and per pupil expenditures.

Q or output was defined in an arbitrary way to include the consumption value of school, drop out rate minimization, vocational preparation (i.e., the proxy was index of student employment), continuation of schooling, scores on two student achievement tests, and percentage planning to undertake post high school education.

Finally Fox made the assumption that schools would attempt to maximize the above defined output. A regression was run to determine the Beta coefficents.

The results from his study, to quote Fox, show that, "there is no meaningful production function for the city of Chicago". This is derived from the fact that school administrators do not attempt to maximize output;

instead their object is to equally distribute inputs to all students throughout the Chicago system. In other words, the partial derivatives; dq/dv_i, dv_1, etc. were rendered meaningless for all the variables except building and teacher age which were beyond the control of administration. In short, expenditures were not being allocated to the v's which contributed the most to output.

The general line of criticisms and comments covered three main areas: the selection of input and output variables, the existence or non-existence of the production function, and possible new testing techniques.

Almost all of the variables were commented upon but the ones which came under heaviest scrutiny were the output measures of vocational preparation and achievement scores. Student employment as a proxy was cited as perhaps negatively correlated with outputs or in other words the part time leaving of school indicated a dimination of school output. Also, the fact that achievement scores are biased by social environment was indicated as a weakness of this measure.

More important criticism was centered upon the existence of a production function. Since presumably outputs were not being maximized, did this imply that there was no production function? The consensus of critical opinion was negative on this question. Regardless of how inputs were allocated (e.g. on an equalization basis) there still exists some function and thus the coefficents which define the relationship between imputs and outputs. Although it was admitted that equalization policies could have important policy implications--added money might not be spent for those inputs which yield the highest marginal returns--still this did not deny the existence of a production function.

The final area of general comment concerned the possibility of setting up a different technique to avoid the equalization problem and to produce a production function which would reflect maximizing action. Intra county or interstate studies were suggested to overcome the handicap of a one schoolboard study. Objections were raised that this did not eliminate the equalization policy and rebuttals were given. Actually there was no clear resolution of this problem.

The net result of both the presentation and criticisms was stimulating even if not conclusive.

J. A. Wilson

Summary of Edward Denison's Presentation

I. The purpose of the study as a whole (that is, not just the chapter discussed in the workshop) was to determine the sources of economic growth in Europe since World War II. Hopefully such a study would be able to pinpoint reasons for the differences between West Europeans and U. S. rates of growth.

II. With respect to the chapter on the education of the labor force, the primary purpose seemed to be the establishment of a sort of social accounting system for human resources with the hope, thereby, of getting at some rate of return to education. By introducing education as a quality variable, Denison was attempting to measure the ability of individuals to do different kinds of work and their ability to do these kinds of work well. No attempt was made to measure contributions to advances in knowledge.

III. Comparisions of West European and U. S. systems

    A. The distribution of education among the labor force

        1. U. S. has a high dispersion

        2. West European countries exhibit high concentrations of level of schooling completed. e.g. In the U. K, large numbers finish at the end of the compulsory age limit but few do before then; and few leave at the (U. S.) high school level.

    B. Computation of a European quality adjustment index:

        1. Required actual distribution of labor force by educational level

        2. Required weights, derived from marginal productivity analysis (using 1949 earnings data--not too much different from current

data but more complete), in order to aggregate various educational levels. These weights are crucially dependent upon the amount of observed income differentials attributed by assumption to education.

C. Gathering the data:

1. Expected West European income differentials to be greater than U. S. (his reasoning was that distribution of educational levels completed implied the higher levels were a scarce factor). Malinvaud (Fr) suggests this also.

2. Data on France (taken to be representative of West Europe) suggest the following index (quality adjusted)

Years of Education	France	U.S.A.	
16	270*	235	
13-15	190	170	
9-12	150	143	(HSG)
		121	(9-13 yrs.)

*Completion of eighth grade = 100

Such an index is designed to relate productivity differentials among members of the labor force to their years of education.

D. Critical Assumptions in International comparisons:

1. A year of education is equal in each country

2. Equal school leaving ages imply equal amounts of schooling in each country--note bias against countries where school entry age is low, e.g. U. K.

E. Conclusions

1. Education has not contributed as much to growth in Europe as it has in the U. S. during the period 1950-62.

Appendix G

Student Papers:

Don DeVoretz, "A Programming Model of Education for Mexico: Preliminary Results"

Peter A. Lundt, "The Factor Proportions of Canadian Foreign Trade and Human Capital"

John L. Melder, "Education and Income Redistribution"

Michael J. Oatey, "To Train or Not to Train"

Allen V. Potts, "Wisconsin's World War I Educational Benefits for Veterans: A History of a Unique Educational Experiment"

SOCIAL SYSTEMS RESEARCH INSTITUTE

Workshop on Economics of Human Resources: Paper 6601

A PROGRAMMING MODEL OF EDUCATION FOR MEXICO
A PRELIMINARY STUDY

by

Don DeVoretz

September 1966

Education as a force in economic development has come into the forefront of analysis and research by economists interested in the growth of economies. Schultz points out the importance of training in the development of the United States by stating that from 1929 to 1956 over $535 billion has been invested in various forms of education.[1] Similar speculations by Denison emphasize the growing awareness of education as a form of productive investment and a growth inducing force..[2]

Unfortunately the same quantitative assessment of education in low income countries has not been made. Many economists believe that the role of education may be similar for less developed countries as it has been in present high income areas. This corallary is doubtful at best and only an expost review of the facts will prove this contention. However, it is certain that skilled labor and educated manpower is a bottleneck presently in low income areas. Whether massive infusions of educational expenditures can lead to self-sustaining growth is beside the point. The relevant problems faced by low income areas is how to best allocate the limited funds available for education and to maximize immediate and future returns to aid in inducing self sustained growth. Expressed in these terms, educational investment does not have to be cited as the panacea for development but only an additional ingredient in the myriad of foods needed for growth.

---

[1] Schultz, J. W., The Economic Value of Education, New York, Columbia University Press, 1963, p.

[2] Denison, E. F., The Sources of Economic Growth in the United States. Committee for Economic Development.

The problems confronting the economist in educational planning are many. Nevertheless, from an economic framework they may be familiarly classified into two categories. The first problem involves answering the question of how much should be spent overall on education. The second problem concerns the allocation of resources that have been made available to education. The first problem must be answered in the context of an overall plan of the economy and priorities for educational investment must be compared to other forms of investment. This in itself is a difficult decision for less developed countries. Since economic priorities are difficult to assess and various theories point to conflicting engines of growth; e.g. agriculture, industry, education, etc., overall investment allocation can be wasteful.

However, even more perplexing and vexing decisions have to be made on the internal level of educational planning. Here the manifestations of poor planning are most obvious. The over investment in lawyers and professionals in less developed countries is often illustrated by their high levels of unemployment. Granted these cases may be more dramatic than they are numerous it still points to the necessity of allocating the limited expenditures for education in a more judicious manner. A solution to this problem can aid in the resolution of the first problem on overall priorities. Measurable criteria which can be used for the internal allocation of existing funds may be used as quantitative criterion for assessing the over all merits of education vs. industry, agriculture, etc.

Starting at the lower level of internal allocation of educational investment economists have been concerned with these problems for many years. Manpower requirement studies have been used with great frequency in deciding the numbers and types of students to be trained in a growing economy. In essence this approach relies on projections of the general growth of certain sectors of the economy and their particular labor requirements in the future. Educational funds are then allocated to those types of education which are expected to be demanded in the future.

Although the manpower requirement technique has been used widely there have been many reservations about its efficacy. First, the technique assumes fixed labor coefficients for labor requirements which do not seem to hold up under investigation.[3] Also, physical projections of manpower needs do not take into account the possible costs or benefits to the economy. Finally, the most serious criticism revolves around the inadequate data available to forecast manpower requirements. This shortcoming of the approach is even more serious when applied to less developed areas. Present data in these economies is both scarce and weak and there is no assurance that their demand patterns will follow present high income economies.

A second technique for determining educational investment priorities is the rate of return approach. Essentially, this technique involves the calculation of a rate of return which equates

[3] Minasian, J. B., "Elasticities of Substitution and Constant Output Demand Curves for Labor", Journal of Political Economy, vol. LXIX (June 1961)

the cast of the investment and its earning stream. In many respects the rate of return approach is at the opposite extreme of the manpower requirements technique.[4] The calculation of the rate of return assumes infinite substitutability of educational inputs, and a horizontal demand curve for labor.

For the purposes of investigating a less developed economy's educational system the rate of return technique is weak in two respects. The assumption of infinite substitutability of educational inputs seems only relevant when marginal changes occur and not under the anticipated major changes in a less developed economy. Also, the solution of the rate of return approach does not simultaneously give the educational input requirements to produce a change in the educational output.

TABLE ONE

Public Expenditures in Mexico
Selected periods, 1940-1960
(per cent of total public investment)

Year	Irrigation	Transport	Electric Power	Education	Other
1939-1940	13.4	52.9	15.1	14.2	4.4
1944-1945	15.7	51.7	11.3	15.6	5.7
1949-1950	13.5	39.3	22.4	16.8	8.0
1954-1955	14.1	34.0	30.9	17.1	3.9
1959-1960	10.4	39.1	29.0	18.5	3.0

Source: Annual Reports of Nacional Financiera 1941-1961

---

[4] Blaug, M. "Private Demand for Extra Education", Economica, February, 1963.

TABLE TWO

Rates of Growth in Mexico's Real National Income

Year	Annual Growth Rate	Year	Annual Growth Rate
1940	1.4	1952	- .2
1941	12.9	1953	-1.2
1942	13.7	1954	7.6
1943	4.1	1955	9.6
1944	8.9	1956	7.1
1945	8.0	1957	4.0
1946	7.0	1958	4.4
1947	1.6	1959	4.6
1948	4.9	1960	5.7
1949	4.7	1961	3.3
1950	10.7	1962	3.1
1951	7.2		

Source: Annual reports of Banco de Mexico, S.A.

A third technique which is available for planning in education is a constrained maximization approach. It will be the purpose of this paper to exploit this technique on the Mexican educational system. Also, the following objectives will be hopefully fulfilled by this paper:

A. a suggested solution to the planning problems on the internal level; e.g. enrollments, expenditures patterns and calculation of costs and benefits.

B. a suggested solution to the understanding of the effects of a change in the parameters of the educational system or the external priority decisions.

Mexico provides an excellent economic structure and environment for a study of educational planning for several cogent reasons. Education has been historically viewed as a prime component for political and economic development by Mexican leaders. An important goal of the Mexican "revolution" is the expansion of educational opportunities in the country. Table one illustrates this goal in a quantitative manner. Since 1940 Mexico has spent almost 16 per cent of total public expenditures on education.

As a less developed country, $630 per capita; Mexico provides a basis for comparison to other low income areas and their educational problems and planning. However, Mexico is not a stagnant low income area as table two clearly displays. Thus, countries below Mexico's absolute and relative growth may be able to profit from any resolution of Mexican educational problems.

The overriding reason for subjecting Mexico to a study on educational planning are the crucial problems which are being ;confronted in general education. Wionczek points out that Mexico has reached a point in development where critical bottlenecks are halting economic growth (1961 through 1963 were relatively stagnant years).[5] An exploding education population (see table three) and a lack of generally educated people among other factors have contributed to the slow slowdown in economic growth. An increasing amount of public investment has been allocated to education to train a growing population while investment in other fields (with possible high returns) such as agriculture have been lagging. It is essential to Mexico's future economic growth that this increased educational expenditure be wisely allocated within the school system and justified in terms of other types of investments.

---

[5] Wionczek, M. S., "Incomplete Formal Planning" in Hogan's Planning Economic Development, 1963.

It is recognized by this author that the latter resource problem, comparison to alternative investments, is largely beyond the scope of economics given the political commitments. Thus, it makes it even more essential to gain insight into the allocation of the given educational funds. Hopefully the following pages of this paper will aid in the understanding of this problem.

Methodology of Constrained Maximization

Any constrained maximization problem is essentially concerned with maximizing some output (or minimizing the cost of an output) given a variety of input constraints. In terms of the usual marginal analysis the object is to allocate the proper proportion of the various limited inputs such that the combination will yield a maximum output.

The interrelations of the inputs and the outputs in a constrained maximization problem may be represented by linear or non-linear functions. For the purposes of this paper the relationship between inputs and outputs will be viewed as linear and hence the constrained maximization technique will be termed linear programming.

Linear programming involves the specification of an objective function to determine the value of the output which is to be maximized.[6] For a general application of the objective function to education the output to be examined is the contribution to national income. Thus, an objective function 1.1 Max $Y=X(Y-y-dc)$ may be specified. The present value of a unit of educational output (Y) to the economy minus the foregone (y) and direct costs (d c) involved in producing the output is the value to maximize under given constraints.

For the specific purposes of this paper a slightly more elaborate objective function will be used. Equation 1.2 represents its form:

---

[6] See Spivey, Linear Programming for a thorough explanation of the entire linear programming procedure.

$$1.2 \quad \text{Max } Z = \sum_{i=0}^{N} X_i \, (Y_i - y_i - C)$$

where

Y_i = the present value (discounted to the present time period under consideration) of earnings derived from activity X_i

y_i = the foregone earnings of the student in activity X_i discounted to time period o.

C = direct costs of education in period o, associated with activity X_i.

The rate of discount used to derive the various present values in the objective function is an expression of the economy's preference for present consumption and future income. The exact rate which equates this desire is difficult to ascertain operationally but a variety of rates may be used to eliminate many objections to a choice of a particular rate. For the purposes of this paper the rate chosen will be assumed constant over the period considered.

At this point it should be noted that two major assumptions are being made in the derivation of the lifetime earning streams. Since the lifetime earnings of a given activity is on a cross sectional basis (by present level of earnings in the particular activity) an infinitely elastic demand curve for this level of attainment is being assumed. Also, viewing education on an attainment basis, rather than by specific occupational preparation, implies a variable input coefficient for labor.

These two assumptions are important but not damaging to the analysis. An infinitely elastic labor demand curve may be accurate for short periods of analysis. Since the procedure in this paper contains this outlook, an infinite demand curve for labor seems relevant. The variable input coefficient also seems to approximate

TABLE THREE

Total Education & Population Growth in Mexico 1950-1962

Year	Number of Students	Average Total Enrollment	Average Total Population	Number of Students per 100,000 population
1950	2,666,119	2,700,000	27,313,000	10,000
1951	2,742,100			
1952	2,868,430			
1953	3,098,100			
1954	3,268,350			
1955	3,526,800	3,800,000	31,499,000	8,720
1956	3,680,000			
1957	3,880,200			
1958	4,125,300			
1959	4,389,600	5,000,000	33,596,000	6,700
1960	4,913,300			
1961	5,249,200			
1962	5,642,900			

Source: United Nations, World Survey of Education 1961 page 786.

the situation in an economy. Study by Minasian confirms the existence of a variable input labor coefficient.[7]

The objective function envisioned by equation 1.2 has other inherent shortcomings. By empirical necessity the income streams generated by the activities only capture the private returns of the individuals. Ideally a social marginal concept should be used. This would allow the capturing of external benefits gained through the individual's investment in the particular educational activity. Since this paper will apply the model to a less developed economy, externalties can assume a great importance. Unfortunately, their calculation is difficult and becomes more undefinable as their importance increases.

---

[7] Minasian, J. B., "Elasticities of Substitution and Constant Output Demand Curves for Labor", Journal of Political Economy (June, 1961) pp. 261-270.

A partial outline of some of the more important externalities portray their importance especially in a less developed economy. Intergenerational effects, e.g. students teaching parents and spreading literacy, may appreciably lower the need for a separate literacy program. This of course can work in reverse when the student teaches his child informally at a future date. . . Also, when students enter the labor force, possible co-operative work with other employees may raise their output and this can be partially attributed to the original educational expenditure.[8]

In essence these external benefits which go largely uncaptured are often cited as an important ingredient to initiating a less developed country into its "take off" stage. At best it is hoped that most of the above externalities are evenly distributed among the various educational activities. Thus, the lack of their calculation would not bias the allocation result from the solution of the linear programming problem. Under this modified assumption and qualification the objective function for education will be calculated in this paper.

Social costs though, can and will be calculated for the formulation of the objective function. Thus, the costs of both the student and society will be included in the direct costs to be subtracted from earnings of the various activities.

Foregone earnings,or y_i in equation 1.2, are an estimate of the cost borne by the student while attending school. Education by its nature requires that the student can not simultaneously attend school and work. Of course, part time work or even full time work (usually at a reduced pay rate) can be engaged in by the student in his off hours. Nonetheless, these alternatives do not allow the same remuneration as a non-student can obtain. Thus, a discounted amount of foregone earnings, net of possible part time employment must be deducted from the students output associated with a particular activity.

---

[8] See B. Weisbrod, "Education and Investment in Human Capital", Journal of Political Economy, Supplement October 1962, pp. 116-120, for a complete discussion of educational externalities.

The maximization of the objective function must be done within the boundaries of the constraints for a meaningful economic problem. The resource constraints define the available amount of inputs which may be used in variable proportions to produce an output from each activity. The exact relationship of the inputs, resource constraints, to the outputs will be discussed below. At this point, it is sufficient to note that the activity levels are restricted by the amount of resources required by each activity and the total amount of resources available.

The production function of education gives rise to three types of constraints. A stock constraint is generated by the educational system in the form of teachers. Continuing students represent a flow constraint, which is endogenously produced by the education process. Finally, exogenous inputs supplied from outside the system, public expenditures, are the third type of constraint.

The two types of endogenous constraints, stocks and flows are a consequence of the nature of the output of education. An output from an activity has three alternatives. It may directly enter the labor force: continue at a higher level of education or teach in the system. Continuing students are then an intermediate input in the educational system and teachers are the capacity inputs for the system. Outputs to the outside labor force may be viewed as the final products of the various activities.

In order to enumerate the constraints more completely it is necessary to discuss the nature of the production function of education. Equation 1.3 represents a generalized form of the production function associated with education:

$$1.3 \quad X_j^p = \min x_{i_j}/a_{i_j}$$

where:

X_j^p = the number of students admitted in activity j in period p.

x_{i_j} = the amount of input i used by activity j.

a_{i_j} = the minimum amount of input i required to raise the level of activity of X_j by one unit.

Thus, the a_{i_j}'s represent the relationship of the resource constraints to the outputs of each activity. In reference to the three categories of resource constraints the input coefficients can be interpreted as follows. Stock constraints, represented by teachers, have a corresponding a_{i_j} which defines the historical student-teacher ratio required to raise the level of an activity. Endogenously generated resource constraints, students, are associated to an output activity by an input coefficient (a_{i_j}) of one. The a_{i_j} coefficients for the exogenously supplied inputs represent the marginally required amounts of resources, e.g. public expenditures per activity level.

The resulting a_{i_j} may be put in the form of a matrix to illustrate the intra educational flows of students and teachers and the exogenous inputs.

The estimation of the input coefficients are based on the historical data available. Time series of teacher-student ratios, expenditures per student, etc., reveal that the coefficients change over time. Usually this is indicative of technological or qualitative changes (less teachers required to produce a given level of output). Solutions to constrained maximization problems do not often attempt to adjust for these changes. The input coefficients are chosen for the latest data and assumed to be constant over the period of the problem. This can be justified on two grounds. Substitution of inputs although possible from an educational standpoint are seldom implemented. In fact, it is often the goal of educational policy makers to equalize the available resources among the various educational activities.[9] On the other hand, varying the input coefficients is possible and a comparison of the optimal solutions can be made to see to what extent they effect the final solution. This last technique will be applied later by this author to account for this critical and serious weakness in the approach.

In order to account for possible political and legal constraints and make the model more meaningful for implementation boundary conditions must be added. These may take the form of 1.4 $X_j \leq P_j$ or $X_j \geq L_j$ where P_j and L_j are the upper and lower bounds respectively. Examples of these boundary conditions are numerous. Primary entrance age children is an example of an upper bound. A lower bound may be a certain level of activation of an activity for prestige reasons, e.g. an engineering school.

---

[9] Fox has pointed out that educators think or act as if the input coefficients are fixed.

TABLE FOUR

Structure of the Model

Objective Function:					
Z_1X_1	Z_2X_2	Z_3X_3	Z_4X_4	Z_5X_5	
Endogenous Inputs					$\leq B_1$
$a_{11}X_1$					
	$a_{22}X_2$				$\leq B_2$
		$a_{33}X_3$			$\leq B_3$
			$a_{44}X_4$		$\leq B_4$
				$a_{55}X_5$	$\leq B_5$
Exogenous Inputs					
$a_{61}X_1$					$\leq B_6$
	$a_{72}X_2$				$\leq B_7$
		$a_{83}X_3$			$\leq B_8$
			$a_{94}X_4$		$\leq B_9$
Boundary Conditions					
X_1					$\leq BU_1$
	X_2				$\leq U_2$
		X_3			$\leq U_3$
			X_4		$\leq U_4$
				X_5	$\leq U_5$

A summary of the constraint conditions and the general outline of the model in matrix notation is such:

X = the column vector of activity levels

Z = the row vector of the net profit coefficients

A = the matrix of input coefficients of the resource availabilities

B = the column vector of constraints

I = an identity matrix

The objective function is now:

1.5 $\text{Max } Z^* = ZX_1$

subject to

1.6 $AX \leqq B_1$

Table four portrays this matrix notation form in tabular form.

Solution of the model yields the optimal level of the various activities. Simultaneously the optimal allocation of endogenous and exogenous inputs is given by the solution.

The dual solution of the problem may also be derived once the primal optimal solution is derived.[10]

The dual problem in an educational model reads as follows:

1.7 $\text{Min } S = u\,(B)$

Subject to

1.8 $(A)\ I\ u \geqq Z$

where I is the identity matrix and hence (A)I is the transpose of A. U refers to the row vector which represents the shadow prices of the constraint equation. The dual problem is then to minimize

[10] It is a theorem of linear programming that a problem which has a primal solution also has a dual solution. See Spivey op. cit. p. 6.

the total value of the resources used by education subject to the constraint that the total value of the resources used at least equals or exceeds the total value of the output. Thus, the resources should be valued as low as possible so that the entire value of the output is accounted.

More than the obvious optimal value revealed by the solution of the primal or dual problem, they also offer much information for policy decisions. The primal solution indicates at what level the various activities should be operated. More important though, the dual and its accompanying shadow prices offer a means of comparison to the outside economy (external allocation problem). If the shadow prices of the resources used in education exceed the estimated marginal productivities in other parts of the economy a quantitative criterion is available to allocate external inputs to the educational system.

This paper plans to employ a two phase analysis of the linear programming technique for Mexican education. First, a static solution will be derived (essentially a one period model) and then the various constraints will be altered to determine the effects on the optimum solution of the problem.

Mexican Education and the Structure of the Model

This section will outline the present state of education in Mexico in terms of expenditures and the structure of the system.

Table One depicted the level of investment in the overall public sector. The original emphasis on transportation and electricity has gradually shifted to social investment with the heaviest increases occurring in education. In 1962, 3.2 billion pesos were allocated to all levels of education. Moreover, education employed 340,000 people directly, and thus can be considered an important user of resources in the Mexican economy. Total school enrollment for 1962 was approximately 5,642,000.[11] Moreover, several studies point to the weaknesses in the present Mexican educational situation. Meyer especially criticizes the system in terms of alleviating the present regional and class disparities in the quality of education.[12] More important though, for the purposes of this study are Meyers' criticisms concerning the lack of proper educational allocation of resources by levels (activities). Meyersclaims that too little money and students are being allocated to vocational and commercial education. No substantial proof is given for this hypothesis but it will be interesting to compare it with the results of the linear programming model.

An unpublished dissertation by Carnoy also reveals some possible areas of weakness in the present educational system of Mexico.[13]

---

[11] United Nations, World Survey of Education, 1963, page 778.

[12] Meyers, C. N., Education and National Development in Mexico, Princeton, N.J. 1965, p. 86.

[13] Carnoy, M., The Cost and Return to Schooling in Mexico,Department of Economics, University of Chicago, Sept. 1964, page 81.

TABLE FIVE

Private and Social Internal Rates of Return
By Year of Schooling, Urban Males,
Mexico, 1963 (Percentage)

Year of Schooling	Private Rate[a] A	Private Rate[a] B	Social Rate[a] A	Social Rate[a] B
2-4	21.1	15.2	17.3	12.8
5-6	48.6	44.9	37.5	34.5
7-8	36.5	31.0	23.4	20.6
9-11	17.4	15.2	14.2	12.3
12-13	15.8	14.6	12.4	11.4
14-16	36.7	39.5	29.5	31.5

Source: Carnoy, M., "The Cost and Return to Schooling in Mexico," p.74.

[a] Returns under A & B result from alternate estimates of the costs of education, A indicating maximum cost and B minimum cost.

Using a rate of return approach Carnoy concludes that highest social and private returns to education occur at the end of primary school and completion of college. Secondary education and vocational training have considerably smaller returns as table five illustrates.

Finally a recent study by McClelland on education and growth indicates that Mexico has been lagging in the relative rate of investment as compared to other less developed countries.[14]

Current educational planning in Mexico has taken notice of these weaknesses and has proposed many measures to alleviate these problems. The current policy of the Secretary of Public Education is to expand secondary school enrollment and to increase the amount of public and private secondary expenditures (the latter represents 30 per cent of total education expenditure) in the future.[15] However, the present plans call for a manpower planning approach of projected needs for specific skills which will in turn determine the allocation of educational investment among the various levels. Also, future expenditures will be allocated with a consideration for geographical dispersion of facilities.

---

[14] McCleland, D. C., "Does Education Accelerate Economic Growth?", Economic Development and Cultural Change, University of Chicago Press, April 1966, p. 271.

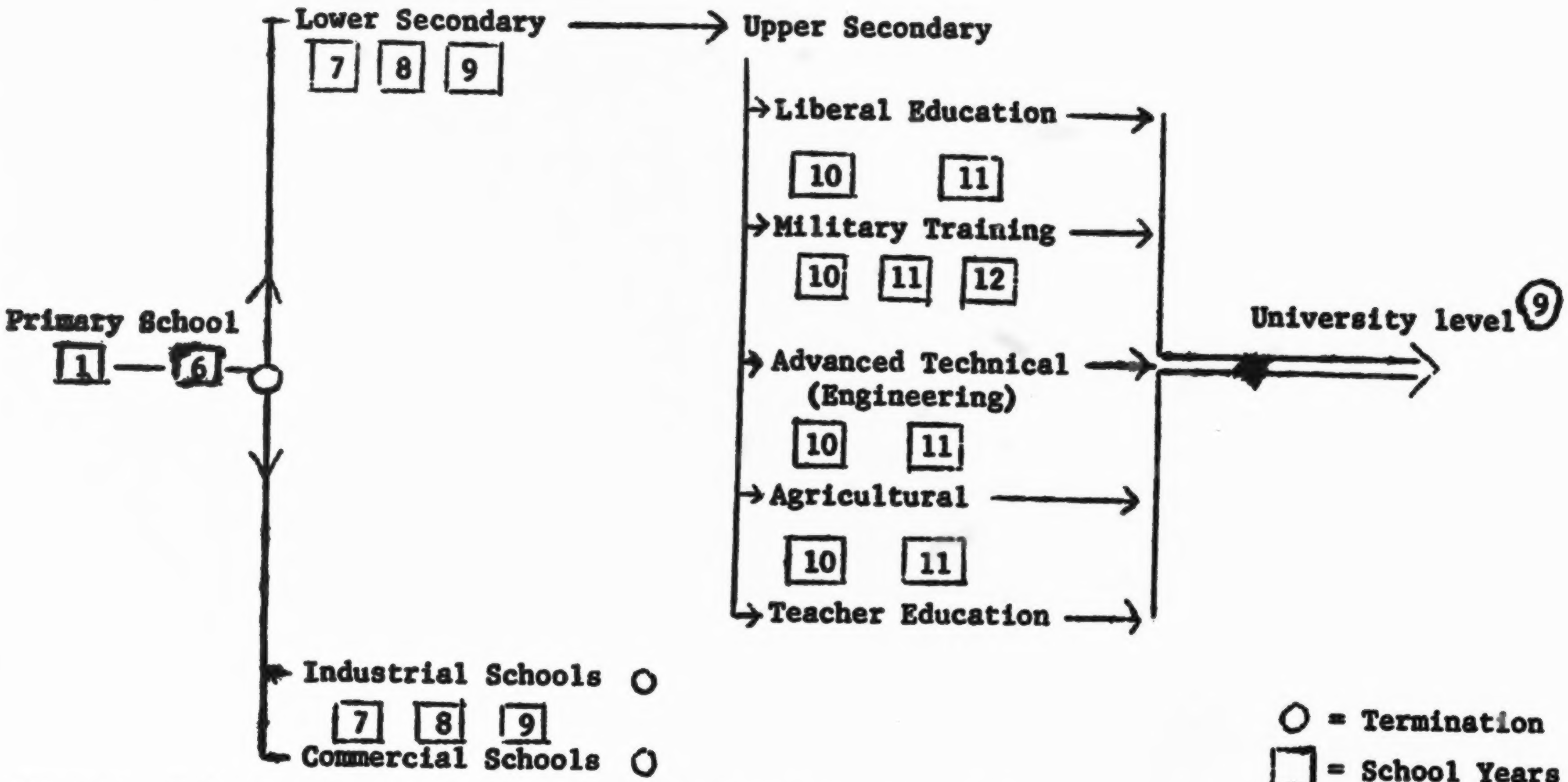
Even this projected planning though may prove inadequate because of the time lag. The problem is both long and short term with the latter problem assuming dominance as the late 1950 population increases become school entrants (see table three). Also, the basic format of Mexican planning relies on the manpower technique which has been subject to heavy criticism. Nevertheless, the results of the manpower planning approach can provide fruitful comparisons to the results of a linear programming solution. Regardless of the differences in policy conclusions it will offer the planner a possible spectrum of choices depending on the assumptions which he feels are relevant.

Table Six depicts the structure of the Mexican educational system. Primary education is similar to the system in the United States with the first six years beginning at the age of six. The course material covered at this level is quite rudimentary with emphasis on the fundamentals for literacy and citizenship. Also, there is some specific education, e.g. homemaking and crafts, in the later

[15] Op. cit., United Nations, p. 774.

TABLE SIX

Structure of the Mexican Educational System


Primary School
1
6
Lower Secondary
7
8
9
Upper Secondary
Liberal Education
10
11
Military Training
10
11
12
Advanced Technical (Engineering)
10
11
Agricultural
10
11
Teacher Education
University level ⑨
Industrial Schools ○
7
8
9
Commercial Schools ○

○ = Termination
☐ = School Years
a Numerous Specialities

Source: United Nations, World Survey of Education, page 773 years (fourth and fifth grades) anticipating the high drop out rates and presenting the maximum of functional education to this point.

Primary education leads to two main alternatives. The lower secondary school provides the prerequisite courses for a continuing education ending possibly with college. The second alternative upon completion of primary school is the industrial or commercial school. Both of these institutions are terminal. As their names would suggest, they are vocationally oriented, offering training in the basic skills, e.g. carpentry, accounting, etc. The duration of both the lower secondary and vocational training is three years with the usual age of entry being 13 and completion age about 16.

Completion of lower secondary training allows the important option of entering upper secondary school. A great deal of specialization takes place at this level in preparation for future training at the college level. The major divisions include general preparation for a liberal arts education at the university level, military training, technical and agricultural preparation. The average length of schooling at this level is two to three years with two years the usual level.

University education is the final level of the Mexican educational system. It is divided into eighteen categories reflecting the various specialities offered at this advanced level.[16] The average age of the entrant to the university level is 18-19 with four to five years needed to complete this advanced training depending on the field chosen.

[16] See United Nations, World Survey of Education 1961, New York, p. 773, for a complete breakdown of the alternatives at this level.

This outline of the educational structure of the Mexican educational system indicates the activities which will be specified in the following linear programming problem. Because of their obvious importance in the above outlined structure the following activities will be used:

1. Primary education X_1
2. Lower secondary education X_a
3. Vocational education (combining technical and commercial training) X_3
4. Upper secondary Education X_4
5. Teacher Training X_5
6. University education X_6

The resource constraints to be used in this specific model of Mexico were chosen on the basis of least substitutability of inputs.

The endogenous inputs are:

1. Primary School teachers (C_1)
2. Secondary School teachers (C_2)
3. Upper Secondary teachers (C_3)
4. Technical Teachers (C_4)
5. Teacher Training teachers (C_5)
6. Primary School leavers (C_6)
7. Lower Secondary School leavers (C_{12})
8. Upper Secondary leavers (C_{11})

The exogenously supplied factors include:

1. Total social expenditure on education (by various activities (C_7 - C_9)
2. Children of age six (primary school entrants) (C_{10})

The presentation of this structure of the Mexican educational system and the historical pattern of rising inputs and increasing student outputs lends credence to a production function similar to the type suggested in the above theoretical section.

TABLE SEVEN

Technology Matrix of the Mexican Educational System[a]

Activities	X_1	X_2	X_3	X_4	X_5	X_6			
Profit (Z_{i_j})	4400	3483	2561	3564	10805	20090			
	.0272						$\leq$	111,134	C_1
		.0877					$\leq$	16,339	C_2
			.0650				$\leq$	2,183	C_3
				.0739			$\leq$	4,784	C_4
					.0800		$\leq$	4,069	C_5
		1.000		1.000		.0812	$\leq$	488,499	C_6
	414.00						$\leq$	2,325,000,000	C_7
		2082.	2082.	2082.					
					3720.		$\leq$	11,268,000,000	C_8
						3720.	$\leq$	373,000,000	C_9
	1.00						$\leq$	6,104,000	C_{10}
					1.000	1.000	$\leq$	79,700	C_{11}
			1.000				$\leq$	35,575	C_{12}

a. Notation of Activities and Constraints found on page 23.

The production function is represented in equation 1.9 as such:

$$1.9 \quad Z = f(x_{i_j} \ldots \ldots)$$

This function expresses the maximum number of students which may be trained with a given amount of inputs. This technological relationship is expressed in terms of resource coefficients or a_{i_j} s.

Table seven represents the outline of the Matrix of the educational system of Mexico. The input coefficients are represented by the individuals elements within the matrix. The coefficients found in the first five rows of the matrix are the historical input-output relationship of students to teachers at the various levels of education. Thus, a_{11} or .0272 in the matrix states that for an increase of one primary student would require an additional .0272 of a teacher.

The cost input coefficients are contained in rows 7-9 of the matrix. Appendix I, page 1, has a complete tabular representation of the total costs for Mexican education. Suffice it to say at this point that the cost concept involved in the resource constraint only includes the public expenditures for various levels of education. Total costs which are attributed to the educational process have been included in the net figure of the objective function. The expenditure figure used for the resource constraint is the difference between the social cost and the private cost of education.

The other inputs, student flows, have the input coefficient of unity. In economic terms this means that it requires at minimum one student to produce one graduate. At first this seems like a common sense treatment. However, the coefficient of unity implies that each student upon graduation may go on to the next level of education only contingent upon having satisfactorily completed the previous level of education. This further implies that no restrictions such as a minimum grade point, test scores, etc., apply to entry after completing a level. Under these restrictions it would undoubtedly take more than one graduate from a lower level to equal one higher level output. The policy of the Mexican educational system does not follow this line at any level hence, a coefficient of unity is appropriate.

The appropriate z values for the profit per unit level of activity can be empirically derived from the net earning profiles of graduates completing various levels of education. The use of the profit unit allows the estimation of the objective function under the possible infinite number of activity levels.[17]

Data collected and estimated by Carnoy supplies the necessary information on level of education and earnings.[18] Table eighteen (Appendix I), states the ultimate net values which are incorporated as the Z_{i_j}'s in the objective function. All data used to calculate the various net profit measures are based on Carnoy's samples from three Mexican urban areas. Although Carnoy points out that his sampling technique may have an urban bias, it should be remembered that the bulk of non-primary education takes place in the Mexican urban areas.[19] Thus for the representation of income earning profiles and related variables to education urban oriented samples seem relevant. Furthermore Carnoy adjusted his data for attendance, father's occupation, industry and place of occupation to eliminate these influences from the earnings profiles.

---

[17] There are in reality an infinite number of feasible solutions within a given solution space. Fortunately, there is a theorem in linear programming which allows us to investigate only the extreme point solutions. The extreme points and only these points will yield an optimum solution if one exists. Of course, the number of extreme points are finite and thus allow a possible solution to a linear programming problem.

[18] Carnoy, M. Op. Cit. p. 64.

TABLE EIGHT

	Actual (1962)[a]	Optimum
Primary students	4,884,930	4,005,150
Lower secondary students	168,800	33,584
Vocational students	86,000	105,264
Upper secondary students	33,575	33,584
Teacher training	42,500	11,131
University training	52,900	22,453

Source: for actual data (a), United Nation, World Survey of Education, page 773.

TABLE NINE

Resource Shadow Prices

Primary school leavers	0
Lower school leavers	0
Upper school leavers	1
Primary teachers 4.138	4.138
Lower level teachers	0
Upper level teachers	46.1535
Teacher training teachers	0
University teachers	0
Vocational expenditures	4.803
Other expenditures	0

Source: Solution of the Linear Programming Problem

---

[19] Meyers, Op. Cit. p. 61.

Primary Conclusions

This section will outline the results of a one period solution to the educational problem presented above. The activity levels and resource shadow prices are found in tables eight and nine

Table eight shows the corresponding changes in the activity levels from the actual figure in 1962 to the solution value after the application of the linear programming technique. The most profitable way of viewing the selection of the optimum activity levels is to follow the sequence of maximization. University and teacher training were introduced into the solution first since they contained the highest profit values over cost. However, they did not reach their actual levels of operation because of the limit on upper secondary student graduates. The upper secondary teaching level reached a maximum and could not supply any more inputs to higher levels because of a resource constraint.[24] Technical training was the next activity to be introduced into the solution and its level exceeded the actual student enrollment by 19,000 students.

The activity of lower secondary training was greatly reduced because of the constraint imposed on upper secondary training and its low return over its costs.

Optimum primary training ran close to the actual level reflecting a positive return over costs but only after other alternatives had been exhausted.

Resource shadow prices are depicted in table nine . The most interesting figure is the shadow value of social expenditures. With

[24] The fact that the optimum level of an activity may exceed its actual level reflects the fact that the input coefficients were derived from an historical average which was below the input coefficient of that year.

the exception of vocational expenditures, all other money spent on education is given a zero value. In essence this means that expenditures on education are not being used to their fullest extent and are in surplus in the system. In terms of the external allocation problem (productivity of educational expenditures vis a vis the rest of the economy) it would appear that money should be reallocated to the outside economy. However, this may be misleading. The other resources and the structure of the educational system may have been bottlenecks and prevented the full utilization of the available monies. Hence, action to eliminate the bottlenecks would probably give a positive shadow value to educational expenditures. The high positive value for vocational expenditures indicates the probable shadow values of other educational expenditures with the removal of bottlenecks.

The positive value for upper secondary school leavers points out an interesting problem. Activation of upper secondary training would be advantageous from the point of view of increasing university and teacher training. However, since upper secondary training contains a bottleneck this is impossible within the constraints of the problem. Of course this has important implications about reallocating resources to upper secondary training.[25]

Shadow prices for teacher resources reflect the activation of the various types of education. Upper secondary education with an increase in enrollment caused a high shadow price for upper secondary school teachers. Primary teachers had a low positive shadow price indicating their constraint on the further activity of primary education. Also, it should be remembered that the model does not allow for teacher substitution among the various activities. If substitution could have occurred perhaps lower secondary teachers would have had a positive resource price.

---

[25] A second run will be attempted with a relaxation of the resource constraints through a reallocation of the surplus resources in lower secondary training.

At this stage of the analysis it would be difficult to make any definite generalizations. However, a few tentative conclusions are in order.

University and teacher training could be run at a higher level with the removal of the bottleneck in the upper secondary training level. Also, the reintroduction of past secondary graduates currently exogenous to the system would prove fruitful.

Technical education rose in its activity level largely by default. Only the resource constraint in upper secondary education initiated the early and high level of technical training.

Primary education is undoubtedly higher than it would be if higher education were running at higher levels. This paradox results from the sequential nature of model which introduced the activity last after all the alternatives had been exhausted. Of course a high level of activation of upper education would keep primary education up but not at the level presented in this solution.

The implications of this model follow somewhat the results of the study by Carnoy (see table five). The fourteenth through sixteenth year of schooling which is comparable to University and teacher training categories received a high private and social return in Carnoy's calculations. Activation of the linear programming model also introduced these educational categories early in the sequence indicating their importance.

Two important differences occur in the respective conclusions of each technique. Although primary education receives a high return in Carnoy's model as well as the constrained maximization approach it is for conflicting reasons. In the linear programming approach primary education was activated by default since the more profitable activities (university and teacher education) had been constrained by secondary education. In Carnoy's analysis primary education fares well on its own profitability with the highest return. Also, Carnoy's model suggest a low activation of intermediate training since its return is less than primary or advanced training. On the other hand the linear programming implies a higher activation of secondary training to further exploit the profits of later training. Furthermore, technical training which was activated in the constrained maximization problem at an early stage falls in Carnoy's lower return category.

The variance in conclusions of these two analyses points out a vital difference in the two methods. A straight calculation of an internal return is unable to capture directly the option aspect of the sequential process of education. The shadow prices of the linear programming model though indicate the scarcity of the various resources used in education and the profitability of reallocation in their direction.

The policy measures of the Mexican Educational Ministry described above are in close accordance with the implications of this model. Their planned expansion of secondary education correctly anticipates the bottleneck revealed by the constrained maximization approach. Although the conclusions were arrived at by seemingly diverse methods - manpower planning and linear programming they both captured the bottlenecks inherent in the educational system. In this case these two methods seem superior to just the straight rate of return method.

Areas of Other Research

The most interesting and fruitful avenue of research which is implied by the above results is in the area of flexibility constraints. By this means flexibility will be introduced into the resource constraints so that reallocation of resources can be anticipated by the model. In particular the secondary teacher constraint will be made more flexible to ascertain its implications on the activity levels.

Of course multiple time period analysis is also another avenue to account for the recursive process inherent in the education process as outlined in the introductory section of this paper.

APPENDIX I

Earnings and Cost Associated With Mexican Education

TABLE TEN

Total Direct Cost Not Borne by Students of Primary Schooling, 1940-62, Mexico
(Millions of Pesos)

Year	(1) Federal	(2) State	(3) Implied Rent To Construction	(4) Sub-total	(5) Private	(6) Total
1940	46	22	2	70	5	75
1945	86	42	8	136	11	147
1950	150	80	27	257	23	280
1953	252	132	45	429	39	468
1955	384	164	65	613	58	671
1956	456	208	74	738	66	804
1957	532	235	85	852	79	931
1958	617	265	98	980	91	1071
1959	799	325	105	1229	114	1343
1960	1113	382	119	1614	150	1764
1961	1172	459	129	1760	164	1924
1962	1368	616	143	2127	198	2325

Source: Carnoy, M. "The Cost and Return to Schooling in Mexico", University of Chicago, 1964, p. 19.

TABLE ELEVEN

Total Direct Cost Not Borne by Students of Higher Education, 1940-62, Mexico
(Millions of Pesos)

Year	(1) Federal	(2) State	(3) Autonomous	(4) Impl. Rent to Constr.	(5) Sub-total	(6) Private	(7) Total
1940	7	3	2	. . .	12	2	14
1945	15	3	3	. . .	21	3	24
1950	19	3	6	3	31	4	35
1953	30	4	6	39	79	11	90
1955	49	7	9	61	126	15	141
1956	61	8	12	69	150	17	167
1957	81	12	11	74	178	18	196
1958	93	12	13	80	198	23	221
1959	120	16	14	83	233	24	257
1960	150	17	14	91	272	27	299
1961	162	21	16	94	293	35	328
1962	183	27	20	101	331	42	373

Source: Carnoy, ibid, p. 21.

TABLE TWELVE

Total Direct Cost Not Borne By Students of Secondary Schooling, 1940-62, Mexico
(Millions of Pesos)

Year	Federal	State	Autonomous	Impl. Rent to Constr.	Sub-total	Private	total
1940	11	5	2	1	19	11	30
1945	30	9	3	2	44	26	70
1950	67	18	5	9	99	57	156
1953	93	28	6	15	142	88	230
1955	139	40	8	22	209	128	337
1956	165	51	9	28	253	157	410
1957	205	66	10	32	313	204	517
1958	232	67	12	37	348	217	565
1959	296	80	13	42	431	261	692
1960	366	94	14	49	523	294	817
1961	455	109	16	54	634	340	974
1962	625	129	22	64	840	428	1268

Source: Carnoy, Ibid, p. 20.

TABLE THIRTEEN

Earnings Foregone and Other Resource Costs Represented By Primary Schooling In Mexico, 1940-54, In Current Prices

(Millions of Pesos)

Year	(1) Per Cent of Urban Students (thous.)	(2) Total Urban Income Fore-gone	(3) Per Cent of Rural students (thous.)	(4) Total Rural Income Fore-gone	(5) Total Income Fore-gone	(6) Total Urban Other costs	(7) Total Rural other costs	(8) Total private direct costs	(9) School costs	(10) Total costs	(11) Per Cent Income Foregone is of total costs
1940	745	46	663	13	59	20	4	24	75	158	37
1945	1082	119	992	35	154	62	13	75	147	376	41
1950	1435	264	1231	71	335	139	30	160	280	784	43
1953	1731	393	1368	98	491	215	42	257	468	1216	40
1955	2028	580	1499	136	716	308	56	364	671	1751	41
1956	2135	664	1545	153	817	342	60	402	804	2024	40
1957	2272	734	1608	166	900	384	68	452	931	2283	39
1958	2429	865	1696	192	1057	457	78	535	1071	2663	40
1959	2620	1035	1769	223	1258	508	85	593	1343	3194	39
1960	2862	1239	2051	283	1522	550	86	636	1764	3922	39
1961	3048	1390	2201	319	1709	604	92	696	1924	4329	39
1962	3279	1548	2364	357	1905	649	102	751	2325	4981	38

Source: Carnoy Ibid, p. 22.

TABLE FOURTEEN

Earnings Foregone and Other Resource Costs Represented By Lower Secondary School in Mexico, 1940-62, in Current Prices (Millions of Pesos)

Year	(1) Per Cent of Students (thous.)	(2) Total Income Foregone	(3) Total Add'l Costs	(4) School costs	(5) Total	(6) Per Cent Income Foregone is of total
1940	63	21	3	20	44	48
1945	108	64	11	52	127	50
1950	158	156	27	120	303	51
1953	200	243	43	181	467	52
1955	234	359	62	267	688	52
1956	259	432	72	329	833	52
1957	298	517	87	421	1025	50
1958	317	606	103	458	1167	51
1959	357	756	118	559	1433	53
1960	396	921	139	659	1719	54
1961	436	1067	154	779	2000	53
1962	489	1244	176	1019	2439	51

Source: Carnoy, Ibid, p.24.

TABLE FIFTEEN

Earnings Foregone and Other Resource Costs Represented by Higher Secondary School in Mexico, 1940-62, in Current Prices (Millions of Pesos)

Year	(1) Per Cent of Students (thous.)	(2) Total Income Foregone	(3) Total Add'l. Costs	(4) School Costs	(5) Total	(6) Per Cent Income Foregone is of Total
1940	31	20	2	10	32	64
1945	38	44	4	18	66	67
1950	48	93	9	36	138	67
1953	55	131	13	49	193	68
1955	61	184	18	70	272	68
1956	64	210	21	81	312	67
1957	68	232	23	96	351	66
1958	74	278	28	108	414	67
1959	85	354	35	133	522	68
1960	95	434	43	158	635	68
1961	109	524	52	195	771	68
1962	119	596	60	249	905	66

Source: Carnoy, Ibid, p. 25.

TABLE SIXTEEN

Earnings Foregone and Other Resource Costs Represented by Higher Education in Mexico, 1940-62, In Current Prices (Millions of Pesos)

Year	(1) Per Cent of Students (thous.)	(2) Total Income Foregone	(3) Total Add'l. Costs	(4) School Costs	(5) Total	(6) Per Cent Income Foregone is of Total
1940	32	31	2	14	47	66
1945	34	58	5	24	87	67
1950	39	110	9	35	154	72
1953	43	150	12	90	252	60
1955	52	229	18	141	388	59
1956	55	264	21	167	452	58
1957	60	299	24	196	519	58
1958	64	351	28	221	600	58
1959	73	444	36	257	737	60
1960	81	541	43	299	883	61
1961	90	633	51	328	1012	62
1962	100	731	58	373	1162	63

Source: Carnoy, Ibid, p. 26.

TABLE SEVENTEEN

Total Costs of Primary, Secondary, and University Education in Mexico, 1940-62, in Current Prices (Millions of Pesos)

Year	(1) Primary	(2) Lower Secondary	(3) Higher Secondary	(4) University	(5) Total
1940	158	44	32	47	281
1945	376	127	66	87	656
1950	784	303	138	154	1379
1953	1216	467	193	252	2128
1955	1751	688	272	388	3099
1956	2024	833	312	452	3621
1957	2283	1025	351	519	4178
1958	2663	1181	417	600	4861
1959	3194	1433	522	737	5886
1960	3922	1719	635	883	7159
1961	4329	2000	771	1012	8112
1962	4981	2439	905	1162	9487

Source: Carnoy, Ibid, p. 28.

TABLE EIGHTEEN

Age, Schooling and Geometric Mean of Monthly Income, Urban Males, Mexico, 1963, Unadjusted

Age	Years of Schooling						
	1	4	6	8	11	13	16
10	128	128					
13	138	176	215				
15-16	274	248	339	574			
18	341	406	547	668	731	794	
22	493	659	782	936	1009	1090	2081
27	556	759	919	1286	1739	1832	3008
32	583	875	1202	1655	2167	2636	5288
39	652	977	1395	2094	2620	3539	6032
49	796	1113	1679	2753	3738	4826	7185
58	770	1136	1990	3087	4625	6480	9230

Source: Carnoy, op. cit., p. 65.

TABLE NINETEEN

Age, Schooling and Geometric Mean of Monthly Income, Urban Males, Mexico, 1963, Father's Occupation Constant

Age	Years of Schooling						
	1	4	6	8	11	13	16
10	137	129					
13	150	179	224				
15-16	320	263	346	543			
18	443	441	559	659	713	722	
22	591	695	799	918	955	997	2060
27	662	799	938	1250	1618	1720	2958
32	680	920	1240	1589	1960	2298	5105
39	773	1020	1392	2015	2458	3230	5625
49	966	1170	1639	2658	3273	4388	6720
58	950	1167	2021	2942	3815	5750	8295

Source: Carnoy, Op. Cit., p. 65.

BIBLIOGRAPHY

Adelman, I., "A Linear Programming Model of Educational Planning, A Case Study of Argentina"

Booth, C. C., Mexico's School Made Society, Stanford University Press, Stanford, Calif., 1946.

Bowles, S., "The Efficient Allocation of Resources in Education: A planning Model with Applications to Northern Nigeria," Doctoral Dissertation, Harvard University, 1965.

Brown, A., et. al., "Output Manpower and Industrial Skills in UK ," in O.E.C.D. Study Group in the Economics of Education, The Residual Factor and Economic Growth , Paris 1964, pp 240-263.

Carnoy, M., "The Cost and Return to Schooling in Mexico," Department of Economics, University of Chicago, 1964.

Day, R. H., Linear Programming and Related Computations,U. S. Department of Agriculture, 1964.

Dorfman, Samuelson, and Solow, Linear Programming and Economic Analysis, McGraw-Hill, New York, 1958.

Du Coff, L., Human Resources of Central America, Panama and Mexico 1950-1980, U. N. Economic Commission for Latin America, New York, 1960.

Government of Mexico, Revista Nacional de Educacion, 1941-1963 Mexico City, Mexico.

Johnson, M. C., Education in Mexico, Viking Press, 1947, New York.

Kneller, C. F., The Education of the Mexican Nation, Columbia University Press, New York, 1953.

Meyers, C. N., Education and National Development in Mexico, Department of Economics, Princeton University, Princeton, N.J., 1965.

Randall, The Process of Economic Development in Mexico, Columbia University, New York, 1964.

Sanchez, G., Mexico, A Revolution by Education, Viking Press, New York, 1946.

Schultz, T. W., The Economic Value of Education, Columbia University Press, New York, 1963.

Spivey, W. A., Linear Programming, MacMillan Company, New York, 1963.

Stone, R., "A Model of the Educational System," Mineria Vol. III, No. 2, Winter 1965, pp. 172-187.

Tenbergen & H. Carrea, "Quantitative Adoptation of Education to Accelerated Growth," Kylas, Vol XV (1962).

THE FACTOR PROPORTIONS OF CANADIAN TRADE: A PRELIMINARY RESEARCH PROPOSAL

Peter A. Lundt

May, 1966

Economics 968

Wassily Leontief's celebrated articles "Domestic Production and Foreign Trade: The American Capital Position Re-Examined"[1] and "Factor Proportions and the Structure of American Trade: Further Theoritical and Empirical Analysis"[2] created what has come to be known as the 'Leontief Paradox'. The theory of international trade has been in a rather unsettled state ever since.

On the surface, the 'Leontief Paradox' appears relatively simple. The Hechscher-Ohlin Theory suggests that a country would tend to export those goods which were intensive in those factors of production in which the country was relatively well endowed; and that it would tend to import those goods which were intensive in those factors of production in which the country was relatively less well endowed. International specialization is based on relative factor proportions.

The United States, which is accepted to be capital intensive vis-a-vis the rest of the world, should export capital intensive goods according to this theory. Leontief's empirical study contradicts this theory. His study seems to indicate that the United States exports labor intensive goods and imports capital intensive goods.

Leontief bases his findings on an analysis of the structure of the American economy which was conducted by the Harvard Economic Research Project. The data base is the 200 x 200 input-output table of 1947. This table describes the flow of goods and services throughout the economy. A column of an input-output table describes the input from all the industries in the economy required per unit of output of a given industry.

Within the flows for a given base year, Leontief assumes a constant-coefficient production function and calculates input coefficients for all industries. If, for example, one million dollars worth of output of industry X used $100,000 worth of industry Y's output as input in the base year, two million dollars worth of industry X's output would require $200,000 of industry Y's output as input. Given the coefficients, one can calculate the requirements throughout the economy for any given change in output.

Using this table, Leontief computed the direct and indirect capital and labor requirements per million dollars worth of output for those industries whose products are traded on the international market. The direct requirements, i.e. the capital and labor requirements, for a million dollars worth of output in an industry, were computed from the 200 x 200 table. The indirect requirements, i.e. the requirements of the output of other industries which the industry in question uses as input, were computed from a consolidated 50 x 50 table.

Using these capital and labor requirements, Leontief examined the relative capital and labor proportions of one million dollars worth of American exports and import-competing output. Since Leontief did not have data on the factor proportions of that foreign output which composes the actual United States imports, he was obliged to compare the capital and labor requirements of one million dollars worth of American exports with the capital and labor requirements of one million dollars worth of American produced import-competing output. Import-competing industries are defined as those industries which have a substantial output in the United States, but compete with like commodities imported into the United States.

Non-competing imports, those imports for which there is no competitive American production, such as coffee, tea and jute, are excluded. Leontief imagines a situation where the United States reduced its exports and imports by one million dollars. The capital and labor requirements to increase import-competing productions, i.e., replacing, are compared with the capital and labor released in the export sector. Non-competing imports are held constant; only competing imports are assured to change.

Leontief's empirical analysis indicates that relatively more labor and less capital are required to produce one million dollars worth of United States exports than to produce one million dollars worth of import-competing production in 1947.

This would suggest that the United States specializes in labor intensive goods. The only explanation which Leontief gives for this is that one man-year of American labor combined with a given quantity of capital must be three times more efficient than foreign labor. He adds that the higher productivity of American labor cannot be due to the larger amount of capital per worker in the United States. If substitution of capital for labor were profitable in the United States, it would also be profitable in corresponding industries abroad. The possibility of technological substitution is available to the whole world.

The controversy surrounding the 'Leontief Paradox' raises several interesting questions. Not the least of which is the need to explore the actual factor proportions of exports and imports in more detail than that of simple capital-labor ratios. Any revision in the present theory of international trade will, of necessity, have to be based on quantitative data.

A quantitative evaluation of the quality of labor would be a definite means of improving the available data. For it seems clear that all labor is not equal on the basis of physical input, even the different amounts of capital combined with it are accounted for.

In addition, there would seem to be an indication that labor in the export industries is of a higher skill level than labor in import-competing industries. Kravis' study,[3] for example, has shown that wage rates in export industries are systematically higher than in import-competing industries. My own research has also indicated that export sector labor is significantly better educated, i.e., contains more human capital, than import-competing industries' labor.

Insofar as research is in progress on the factor proportions of United States foreign trade, I should like to explore the factor proportions of Canadian foreign trade with especial reference to educational requirements. For it is desirable to study the factor proportions of foreign trade of more than one country in order to estimate the effect of peculiar national characteristics and/or conditions on the factor proportions of foreign trade.

The direct and indirect capital and labor requirements of Canadian foreign trade have been calculated by Donald Wahl,[4] using the Canadian input-output matrix for 1949, and the capital requirements estimated by W.C. Hood and Anthony Scott.

Using the Canadian Census for 1951, I can estimate educational levels, occupational distribution, skill levels, and distributions by sex and age for Canadian industry on a sector by sector basis. These sector by sector estimates can be converted to the 22 sectors used in the input-output matrix developed by Wahl.

Using Theodore Schultz's estimates of resource costs of education in the United States[5] as proxies for Canadian costs, I can estimate human capital requirements for Canadian foreign trade. These could be grafted onto the existing capital-labor requirements for Canadian trade to produce a Leontief type estimate of capital, both human and physical, and labor requirements of Canadian trade.

The analysis can be developed further, however. The industry by industry requirements of education, skills, occupations, etc. can be regressed on the industry by industry share of Canadian trade to yield quantitative estimates of the importance of these factors in Canadian trade. An industry's share of foreign trade can be expressed as its share of aggregate Canadian trade, of world market, of its change in share of world market, and/or its share in Canadian trade towards certain regions such as the United States, Western Europe and the lesser developed countries.

Several problems which are likely to develope in the course of this study can be anticipated in advance. The labor requirements of Canadian trade estimated by Wahl were established on the basis of wages and salaries paid, rather than on a physical input basis. Since it could be expected that wage rates and education are correlated, an upward bias in the effects of education could be introduced. This could be controlled for by re-evaluating the labor coefficients in terms of man-year inputs. The wage structure in each industry can be derived from Canadian Census data, and can be used to convert the labor coefficients to a man-year basis.

A further problem would be that of natural resources. Many suspect that an endowment of natural resources strongly influences the structure of a country's foreign trade. This could swamp the effects of differing educational levels in the various industries. This could be corrected by using an export requirement for natural resources derived from sectors defined as natural resource intensive. Jaroslav Vanék has estimated natural resource requirements for the United States by this method.[6] These requirements could be used as a proxy in the Canadian case.

It should be noted that this study could be extended to include not only more data, but newer data. More variables, such as research and developement expenditures, degree of concentration, well defined natural resource requirements and newness of capital, could be considered. In addition, The Dominion Bureau of Statistics is schedualed to publish an input-output table for 1961 in the near future. This could be combined with the Canadian Census data for 1961 to update the study. The two sets of results could be compared to give a very limited intertemporal view.

FOOTNOTES

1. Leontief, Wassily, "Domestic Production and Foreign Trade: the American Capital Position Re-Examined", *Proceedings Of The American Philosophical Society*, 97:4:1953, pp.332-349.

2. ...."Factor Proportions and the Structure of American Trade: Further Theoretical and Empirical Analysis", *Review Of Economics And Statistics*, 38:1956, pp.386-408.

3. Kravis, Irving B., "Wages and Foreign Trade", *Review Of Economics And Statistics*, 38:1956, pp.14-30.

4. Wahl, Donald F., "Capital and Labor Requirements for Canada's Foreign Trade", *The Canadian Journal Of Economics And Political Science*, 27:1961.

5. Schultz, Theodore W., *The Economic Value Of Education*, New York, 1964.

6. Vanek, Jaroslav, *The Natural Resource Content Of United States Foreign Trade 1870-1955*, Cambridge, 1963.

Hansen

SOCIAL SYSTEMS RESEARCH INSTITUTE

UNIVERSITY OF WISCONSIN

WORKSHOP ON ECONOMICS OF HUMAN RESOURCES: PAPER 6604

THE EFFECTS OF FAMILY INCOME ON POST-HIGH SCHOOL EDUCATION PLANS: A CASE STUDY

1. Special characteristics of sample & implications for results.
2. Theoretical model & relevance of other studies
3. Failure to fully exploit data, IQ, class rank, parental
4. Conclusions re: policy
 - discriminating — point
 - other factors
 - post 1960
 - redistribution

By

John Lewis Melder

November 28, 1966

The positive effects of education on income levels are accepted today as an economic verity. The literature is swollen with articles attesting to the fact that a person's income is, in large part, a function of his educational level.

This paper proposes to reverse the emphasis and focus on the relationship between income levels and the amount of education sought. The question to be studied is: What is the relationship between family income and the amount of post-high school education a child seeks?

Also to be included in the analysis will be the effects of ability and father's occupation on the child's educational decision.

Why ask this question.

What's rationale for examining these

The three variables for which correlation with the criterion variable (the amount of education sought) to be estimated are parental income, father's occupation, and student's ability. Attempts will be made to determine which of these variables is most decisive in prompting a student to opt for more education.

Furthermore, the study will attempt to separate out the level at which income becomes a decisive factor in a student's decision as to whether he should attempt a post-high school educational program, whether it be at the college level or some other.

Why not derive an income level wh

This is decisive

To facilitate this, students will be divided into two groups--non-poor and functionally poor. "Functionally poor" is, admittedly, a subjective classification which attempts to cover students whose parents--while not poor by federal definitions--lack the finances to assure their child a relatively easy transfer from high school to post-high school education.

Such families would find it difficult to absorb the added cost of the post-high school education while, at the same time, realize a real loss in the income foregone while the high school graduate continues his education.

At what income level do these two factors come into play? While any such amount is open to argument, I have selected the figure of $4800 for a family with two children. For each additional child $600 will be added to this figure. Thus, a family of four children and two parents with an income of $6000 or less will be considered functionally poor.

Why ??

In defense of this figure let us look at the $4800 sum. A family of four (including two children) would pay approximately $286 in federal income taxes, $120 in state income taxes, and $25 in sales taxes.[1] Its after-tax income would be approximately $4379 or $365 a month. Figuring $185 for rent and groceries and $30 for insurance, the family would have $150 a month for entertainment, medical bills, major durable goods purchases, auto expenses etc.

Where do these wh come fr See Survey of Consume Expendi

This amount would hardly leave such a family enough to absorb $569.56 (for women) and $465.39 (for men) which were the mean family contributions for students attending Wisconsin Center schools in 1964-65.[2]

These could b the result o past sam e.g. $\text{Wealth} = \sum_{t=1}^{n} S_t$ ove lifetime of child.

Since the center system education is one of the least expensive available to students in the state, these mean figures may be taken as minimums. With these considerations in mind, then, I believe the above definition of "functionally poor" -- while not beyond reproach -- is a workable first approximation.

1/ Estimates based upon "Instructions for Preparing Your Federal Income Tax Return Form 1040 for 1965," Internal Revenue Service, Washington, D.C. 1965.

2/ "Costs of Attendance and Income of University of Wisconsin Center Students: 1964-65 Academic Year," by L. Joseph Lins, Allan P. Abell, and Richard Hammes, Office of Institutional Studies, The University of Wis., Madison, May 1966, p. 27.

Does the fact that exps are shared imply that decision-making is shared? What did it value

One of the assumptions, of course, is that parents share in the child's decision-making process about post-high school education. In other words, this is not a decision a child makes by himself. The findings of the Lins-Abell-Hammes study cited above make this assumption clearly reasonable.

[illegible] the process

This technique embodied in this study, of course, considers the decision process from an income approach. It ignores the behavioral question, which is: Given the income constraint, how do people classed as functionally poor actually act with respect to financing their children's post-high school education?

Persons under an income constraint still may decide to encourage and finance their children's further education, indicating it has a relatively high degree of utility for them. This aspect of post-high school education decision-making will be developed later in this paper.

SAMPLE

The sample used in this study was the 1964 senior class at Sun Prairie High School in Sun Prairie, Wis. The district is a joint school district and includes the City of Sun Prairie, the Towns of Blooming Grove, Bristol, Burke, Cottage Grove, Hampden, Sun Prairie, and York.

The area is largely rural with a population of 20,997, according to the 1960 Census of Population with almost 14,000 concentrated in the City of Sun Prairie (4,008) and the Town of Blooming Grove (9,709).

The median income in the City of Sun Prairie, according to the 1960 Census (data on the other towns was unavailable), was $6,919. Median school years completed was 11.4 and the percentage of the adult population who completed high school was 47.5%.

In June 1965, 5,430 of the population consisted of children up to ages of 19. In June 1960, the figure was 2,768, giving an increase of 96.2% in this age group in 6) years.

The 1964 senior class consisted of 135 students who were enrolled in September 1963, four of whom dropped out before graduation in June 1964.

-18 sr
chil

METHODOLOGY

As mentioned above, the purpose of this study was to draw correlations between student's ability, father's occupation, and family income and whether or not the child opted for post-high school education.

From school records, the class rank of each student was obtained and this was used as a proxy for ability. This is a subjective choice but one dictated by the limitations of data. I.Q. scores and achievement tests were not available for all the students, while the class ranking was.

Why not get [illegible] for [illegible] students [illegible] available

The class, then, was divided into quarters, based upon the class rank and students were given a number of 1, 2, 3 or 4 based upon their rank.

why not use farm breakdown

total income

Income data on the families for the year 1962-64 were obtained from the Wisconsin Department of Taxation along with father's occupation. Correlations were estimated using both the 1964 and the mean income figures.

[illegible]

Because of the haziness of the occupational descriptions given in the tax forms, four general occupational classes were used, e.g., executive, skilled, farmer, and unskilled and retired. The executive group included the self-employed, managers, salesmen, and professionals. The other categories are self-explanatory.

Occupations were used in an attempt to capture home environmental influences on a student's decision on post-high school education. In the

How effectively does occup. reflect environment

estimations, executives were given a rank of 3, farmers and skilled workers 2, and the unskilled and retired 1.

Again, the ranking is subjective, but I believe not unreasonable.

what does th
mean ?

Post-high school education plans were obtained through telephone interviews with the parents. Also obtained were the educations of the parents, where this information was freely given (In many cases, the parents had no qualms about discussing their children's activities after high school but refused to discuss their own educational attainment).

Educational attainment levels were obtained for 64 mothers and 61 fathers. The data revealed that 40 (or 62.5%) of the 64 mothers had a high school education or better, eight had some college education, and 6 or 9.3% were college graduates. The mean years of schooling for the group was 11.3 years.

Median and ? '
Do Med + $\bar{X}$ d
this much

[illegible] or
[illegible] n
Sn ?

For the fathers, 33 (or 54.1%) had a high school education or better, 7 had some college education, and 5 (8.2%) were college graduates. The mean years of schooling for the group was 10.8 years.

ditt

The mean level of schooling for both groups combined was 11.04 years.

In estimating the correlations, a "yes" answer was scored 1 and a "no" answer was scored 0. "Yes" meant a student proceeded to college, nurses training, or a vocational-technical school education after high school.

The "nos" either took a job, entered the armed services, married, or were not employed.

For the "yes" answers, the parents were then asked if the child remained in college, nurses training, or vocational-technical school.

Of the 89 responses, 36 students entered college and 12 later dropped out. Of 4 who entered nursing, 1 dropped out.

89 out of 135
Where were the
rest ?

Of 8 who entered vocational-technical schools, 7 dropped out. However, this may imply too strong a conclusion. In the interview, the parent was asked if the child still remained in the school of his choice and the yes or no reply undoubtedly was ill-conceived with respect to the voc-ed students because some of them may have finished their training courses in the two years that had lapsed since graduation. Thus, the seven of eight "dropouts" in this case may have been graduates.

The above, then, outlines the data-gathering technique and the uses to which the data was put. Unfortunately, the means of obtaining the data had inherent constraints.

For example, of the 135 students, income tax data was available for only 98 in 1964, 91 in 1963, and 90 in 1962. Of this group, responses to the telephone interviews amounted to 92(actual responses, but for 8 of those responding income data was unavailable).

As a result, the sample size dwindled from a possible 135 to 84 (or 62.2%) for all variables.

The erosion of the sample size is inevitable, however. The principal cause is the lack of income data on all families in the sample. Because families do move and move from state-to-state, it is unreasonable to expect that income data will be available on all families in a sample. Secondly, the movings after graduation erode the number of responses to a telephone survey and the telephone survey was selected because (according to H. P. Sharp, Director of the Wisconsin Research Survey Laboratory) responses to telephone interviews are much better than mailouts.

Why not use number of children as added measure of ability to pay!

Despite the fact that data on all variables was available for 84 or 62.2% of the total sample, I do not believe the sample was meaningfully biased. The limitations placed on data collecting do not imply consistent bias.

Reasons?

phones?

For example, assuming the parents were law-abiders, there is no reason to believe that the unavailability of income (and, thus, occupation) data would follow income (or occupation) lines. Following the same reasoning, I do not believe telephone responses would indicate that those whose children selected (or did not select) some form of post-high school education were more likely to answer their phones. Thus, I do not feel the sample used was meaningfully biased.

But characti of movers may differ from nonmovers. e.g., effect of Truax Field close-dow

FINDINGS: TAX CONTRIBUTIONS

Proponents of public education point to its income redistributional effects and the sample studied here supports this argument. What is the argument?

State income tax payments were studied for the year 1964 with the following results:

1. For 19 functionally poor families the average family size was 4.3. For 76 non-poor families the average family size was 4.5.

2. The 19 functionally poor families paid a total of $843.05 or $44.37 per family in state income taxes in 1964. This averaged $10.28 per dependent.

3. The 76 non-poor families paid $28,548.43 in state income taxes in 1964 for an average of $375.63 per family and $84.72 per dependent.

Approximately 45% of state revenue is earmarked for education. The above findings show that the average non-poor family pays 8.46 times as much in taxes as the functionally poor family and 8.24 times as much per dependent.

Since all 95 students in the sample graduated from high school, they all shared equally (abstracting from qualitative considerations) in public school education.

also property tax
farmers pay high prop tax
others pay high y tax

It should be borne in mind, however, that state income tax revenues do not comprise the full support for school systems. Property taxes are the biggest source of local school district revenue and, at least, some of the functionally poor included above undoubtedly were property owners since four of the 19 were farmers and, reasonably, could be expected to own their own property.

Nevertheless, the data does show a more than proportionate share of state income taxes being paid by the non-poor (as expected) and indicates to some degree the income redistribution effects of such a tax when used to support education.

Careful. Some of tax money supports college education that some of them are getting at a bargain rate!

FINDINGS: CORRELATIONS

The correlations run on the independent variables (1964 income, mean income 1962-64, poor and non-poor families, father's occupation, and class rank) with the dependent variable (post-high school education plans) revealed unexpected results.

The hypothesis tested was: There is a meaningful correlation between income levels and a student's decision to choose some form of post-high school education.

The correlations lead to the rejection of the hypothesis.

ndard errors

To be significant at the .05 level, a correlation of .2152 (plus or minus) was essential. Only one of the correlations came close to this. The correlation between rank in class and the decision to select a post-high school educational program was .2144, which may be interpreted as an indication of some positive correlation between the two variables.

r or r²

Table I gives the complete results:

TABLE I

VARIABLES	CORRELATION (r)
Post H.S. Education and Class Rank	.2144
Post H.S. Education and Mean Income	.0671
Post H.S. Education and 1964 Income	.000068
Post H.S. Education and Poor/Non-poor Classification	.1166
Post H.S. Education and Father's Occupation	.1210

regression coefficien

The correlation with the poor/non-poor classification led me to believe the definition of "functionally poor" may be too high. Correlations then were estimated using income levels of $4,000 and below and $3,000 and below and ignoring the number of dependents.

4 occup
of class ra
3 income

For the $4,000 and below figure, the correlation was .158, and for the $3,000 and below, the correlation was .17--both not significant.[3]

CONCLUSIONS

The study again illustrates the fact that the conventional knowledge and empirical results often differ markedly. Intuitively, one would expect a significant correlation between a family's income and a child's post-high school education plans. But the data revealed no significant correlation. In fact, none of the correlations (except that for class rank) was significant. How can these findings be interpreted?

|| Students may
work,
Transitory m

---

[3] Twelve families of the 84 had incomes of $4,000 or less and in these 3 students continued their education beyond high school. Six families had incomes of $3,000 or less and in these one student continued his education.

Judging from the correlations, post-high school education plans do not depend upon parental income, father's occupation or class rank. One is left with the feeling that if a child has any chance of taking advantage of a post-high school education, he takes it. The expected inhibitions--how income, low class rank, environment--do not appear to come into play. In other words, families in the sample appear to have a high utility for education.

p. 5. Why didn't you use education of parents? for smaller sample? Also, family size

This leads one to conclude that behavior may not be a function of what one would intuitively feel are the operative variables. Perhaps one should turn to variables such as aspiration level, parental feelings of responsibility towards a child after high school, the family's valuation of education, how a family perceives the potential for borrowing for education, and the expected payoff from education.

The policy implications, especially as related to the demand for education after high school, are immense. Assuming the sample is not atypical, it may well be that present forecasts of college class sizes of the future are understated. It well may be economists and educators do not yet comprehend the effects today of our society's overwhelming emphasis on education.[4]

Yeah but how many kids from well off families did not go on to college?

After carrying out such a study, one is left with an intuitive feeling that something has happended--perhaps very recently--to change parents' views of education. One feels that perhaps education has assumed a bigger role among families recently; that perhaps the selling job done by educators since the late 1950s has served to shift the demand curves for education quite recently.

On what bases do you develop this feeling?

---

[4] I hope to expand the present study to include several school districts and derive similar correlations in an attempt to determine how--and if--the correlations vary.

Many of the studies done in the general area of the economics of education have dealt with persons in their 30s or above. Payoffs from education and factors affecting education decisions most often seemed to be derived from this age group.

But now I feel we should take a look at what has happened since, say, 1960, or perhaps a more recent date. Admittedly an intuitive feeling, I believe it provides a testable hypothesis: The demand for post-high school education has shifted markedly recently, swamping the effects of what previously had been considered inhibitory influences.

Such a hypothesis, I feel, opens an avenue of meaningful research.

APPENDIX I

APPENDIX I

The variations in income over the three year period (1962-64) were both volatile and difficult to relate to decisions regarding education plans.

Table I gives the mean variation by job classification and shows that the most volatile groups as far as income variation is concerned were the skilled and farmer groups. Both averaged 60% variation or better.

Table II shows how the income varied.[1] The mean variation for the group was 51.821%, which means a man with $6000 income in 1962 might expect his incomes in 1963 and 1964 to vary between $2000 and $8000. Furthermore, (as Table II shows) for 37 or 43% of the group their incomes would swing up and down during the period under study.

But may reflect
move into
Wisconsin
rather than
income behavior.
Or move out
of state.

The implications for making four-year plans for expenditures on a college education are vitally important. Assuming that the variation detected from 1962-64 continues, how do parents project their ability to send a child to college? On what year's income do they base their decision?

In the correlations run above the mean income and the last year's income (1964) were used. But the theoretical relevance of this technique can be questioned. It is not evident that these are the two correct income benchmarks to use. A permanent income hypothesis seems more relevant here.

We have a situation, for example, of a skilled worker whose income will vary on the average of 63% over the next two years, asking

---

1/ The sample size in the two tables differs because three-year income figures were not available for the 88 persons checked in Table I. For two of the 88, data was available for only two years. Thus their average was a two-year rather than three-year mean.

TABLE I

Variations in Income by Job Classification*

CLASS**	NO.	MEAN
Executives	25	49.202%
Skilled	18	63.583%
Farmers	16	60.793%
Unskilled	26	37.623%
Retired	3	78.28%
Average for Group	88	51.821%

*Source: Wisconsin Income Tax Data 1962-64

**The Executive classification included managers, professionals, the self employed, and sales personnel. The other classifications are self-explanatory.

TABLE II

Directions of Variation in Incomes*

UP	DOWN	CONSTANT (10% variation or less)	UP AND DOWN
29	5	15	37

*Source: Wisconsin Income Tax Data 1962-64 himself in 1964 whether he can afford to help finance his son's college education over the next four years.

Let us assume this hypothetical skilled worker made $8000 in 1964. Will his income in 1966 be $2960 or $13,040 in 1966? Such a question is not unrealistic. The range of change for the 18 skilled workers studied was from a low of $264.44 (up and down variation) to $12,220.19 (up).

The average change in income for the group from 1962-64 was $3369.25. Of the 18, the variation for 7 ranged from $3353.38 to $12,220.19; five others ranged from $702.50-$2536.88, and six incomes ranged from $264.44-$632.63. For 10, the variation was $1031.34 or more.

Of the 26 unskilled workers included in the study, 18 had income variations of $1211.12 or more, and 10 had incomes that changed by as much as $2000.05 or more in the period. The former figure ($1211.12) would mean a weekly difference of $23.29 a week. And as Table I shows the unskilled group had the lowest (37.623%) income variation of the five classifications.

The point here is that income variations over even short periods of time are a fact of life; the variations can be wide (changes of 80% or more were found in 20 of 88 (or 22.7%) of the cases studied); their direction is not predictable, and their impact on family budget decisions can be great.

Furthermore, it should be pointed out that the variations were recorded during a period not marked by sharp cyclical fluctuations.

The role of wives as income carriers loomed large for the families studied. For example, income tax data for 1964 was available for 112 families. Of these, 63 returns showed wives with incomes over $700 a year and in 50 of the 63 cases, the wives earned $1200 or more.

Also in the data for the three-year period there seemed to be some evidence the wife's income varied inversely with the husband's. In other words, when the husband's income dropped, the wife increased her working hours to take up the slack.

This trend, although not pronounced, appears to indicate the families had some minimally acceptable income level. When the level was approached, the wife became more active in the labor force.

Thus, the role of the wife in post-high school education plans also looms large. In families where education for the children is esteemed and income is low, it is reasonable to assume the wife may serve as the financing agent.

The above, I believe, all points up the fruitfulness of more research into how families form income expectations, how the wife's role as a wage earner enters into the formulation, and what impact the role of the wife as a wage earner and the evidence of income variation enters into the decision of whether or not a family can finance their children's post-high school education.

APPENDIX II

APPENDIX II

Are the functionally poor a stable segment of the population, or does poverty vary from year to year?

Intuitively, one would feel there is a certain variation involved with the functionally poor concept and the data bears this out.

As Table I shows, the number of families classified as functionally poor varied from 27 (of 90 available tax returns) in 1962 to 31 (of 91) in 1963, and 21 (of 98) in 1964.

In the three-year span, 40 families qualified as functionally poor in one year or another. Of these, 16 families were so classified for all three years; 7 families for 2 of the 3 years, and 16 were so classified for 1 of the three years.

For 16 families then, functional poverty was a fact of life from 1962-64. Six of the 16 were unskilled workers, four were farmers, four were retired, one was in the executive class,[1] and one was unemployed and received welfare payments.

Of the 39 families (excluding the welfare recipient) classed as functionally poor in at least one of the three years, seven were executives, five skilled workers, 13 farmers, nine unskilled workers, and five were retired.

As a group, (excluding the retirees) farmers fared worst. Thirteen of the 16 farmers included in the sample were functionally poor at least one of the three years. Four were so classed for three years, three for two years, and 6 of the 13 were functionally poor in 1 of the 3 years.

1/ Again it should be pointed out the catch-all characteristics of this class which include the self-employed, sales personnel, managers, and professionals.

The findings illustrate further the uncertainty introduced by the income variable in making decisions about post-high school education. Not only can income vary greatly over a short span of time, the variability can drop a family into a functionally poor group or raise it from this group. The implication is especially relevant to farm families whose income--characteristically on the lower levels--can vary so as to dip this group into and out of the functionally poor class.

Furthermore, the findings point up the necessity for policy makers to look at poverty (in the broader sense) from a time series as well as a cross sectional approach.

Cross sectional data defines poverty at a point in time. But poverty is not a constant. It moves. Time series data (as evidenced even in this limited sample) reflects these movements and can serve as an aide in long-range anti-poverty programs.

TO TRAIN OR NOT TO TRAIN...

M. J. Oatey

E.P.S. Seminar
201 North Hall
April 25, 1967
3:30

"Training is a good thing" - this is the general impression created by a survey of industrial training literature. However, attempts to justify training on an economic basis, or to measure the appropriate costs and benefits, are conspicuous by their absence. The following quotations are typical of unsubstantiated statements in the literature:

> It (training) cannot be ignored without costing the company money. (DePhillips 1960, p. 6)
>
> The question is not 'is training needed?', but 'where is training needed?' (Fryer, 1956)
>
> Management will secure more than a fair return on its investment (in training). (DePhillips 1960, p. 21)

Admittedly, the more enlightened indicate that economic justification is desirable: that decisions will be "governed by relative long range costs" (Proctor 1961, p. 31), and that a determination should be made as to whether benefits exceed costs (McGehee 1961, p. 9). But this is little more than lip-service since no indication of how the costs and benefits of training are to be measured is given, and any general discussion on the alternatives to training is absent. Indeed, in three of the four books on training so far quoted there is no entry equivalent to "costs of training" in the index, and the fourth (McGehee 1961) only pays the lip-service indicated above.

In the "opposite camp" of general management, there is noticeably less enthusiasm for training. One training specialist has refered to the "training is a luxury" attitude of some managers (Fryer 1956, p. 30), while another observer believes this is only to be expected - "It is only natural that management should resist what appears to them to be a waste of money" (Al-Arabi 1965, p. 497). Doubtless one reason for the scepticism regarding the value of training is the traditional attitude of economists and non-economists of education as an item of consumption. But there are other significant reasons peculiar to the industrial training context as this paper will show.

Still another attitutde toward training is that it is inevitable. Eckaus (1963) has suggested that "on-the-job training is an unavoidable joint product with the firm's regular output, that is, that neither marginal nor average costs of production are completely separable."

Thus training has been variously characterized as indispensible, quite dispensible, and unavoidable. Although individual instances could be cited to support these views (coupled with appropriate definitions of training), this paper will reject all three as valid generalizations. Instead, the view taken here is that training is a function in its own right, that it is an investment in human capital with identifiable and measurable costs and benefits, that there are always alternative processes that could be substituted, and hence that a deliberate and rational decision on training based on an economic analysis can and must be made.

Industrial skills. The term 'skill' is defined as any behaviour, verbal or non-verbal, an employee is required to perform in order to carry out his duties. Some skills will only be usable in one particular company, while others will be generally applicable to all firms in a certain industry or geographical area. Following Becker's (1964) useful notation, skills applicable only to one firm will be classified as specific (to that firm); while skills applicable to two or more firms will be regarded as general skills. An example of a general skill would be shorthand, typing, while skills acquired in a firm using a unique patent manufacturing process would tend to have considerable specific component.

When a firm places an employee in a job position, it anticipates a certain marginal product. In order to achieve that marginal product the employee must perform the appropriate tasks to a certain level of competence, which I will call the CRITERION level of skill.

The firm may expect a newly hired or transferred employee to perform at the criterion level of skill immediately, or it may be prepared to wait a week, a month or even years (indeed it will usually have to wait where specific skills are involved). Thus a new operator may only produce 70 pieces a day and take one week to achieve the criterion of 100 pieces a day by learning from experience; a new salesman may be unable to achieve the sale of the criterion level of goods until he has undergone a one month training program; while a production manager's assistant will often not be able to ensure his department can achieve the criterion level of output until he has been through numerous training courses and has had several years experience with the firm.

Assuming the criterion to be realistic and attainable by the employee concerned, performance below the criterion can be eliminated by a process of SKILL AQUISITION and improvement. It is the costs and benefits of, and the alternatives to, this process of skill acquisition that forms the subject of this paper.

I. ALTERNATIVES TO TRAINING

Training is obvious form of providing for skill aquisition. However, there are always alternatives, which must be considered when making a decision regarding the undertaking of a training program.

Formal training, informal training, and learning from experience.

There is little difficulty in recognizing so-called "formal" training where instruction takes place in a classroom or vestibule school using a teacher or audiovisual media, and/or where practice occurs in a supervised specially controlled environment. However, as the location of the instruction and practice moves from the classroom, that is the more "informal" it becomes,[1] fewer people would classify it as training - or at least that it involves the same economic and psychological factors as those of more formal training. And the "extreme of informality", the aquisition of a skill by learning from experience, is seldom considered by training officers to be an activity that could be legitimately substituted for formal training.

---

[1] For example, the "sitting by Nellie" method, whereby the new trainee learns a skill by watching and copying an experienced worker on the job.

Yet formal training programs and learning from experience are both means of providing for skill acquisition up to the criterion level, and in both cases this can only be achieved at a cost.[1] Indeed, it is tempting to define training as any investment or activity resulting in skill acquisition, as Mincer (1962, p. 51) does. However, in order to make an important distinction later on concerning skill acquisition after the criterion has been reached, I shall use the following definitions:

TRAINING is the deliberate modification of an environment for the purpose of improving a person's skill at a task (the modification may be made by the person or by an external agency);

LEARNING FROM EXPERIENCE is the improvement of a person's skill at a task by the normal execution of that task with no deliberate purpose of improving it.

These definitions have the advantage of conforming fairly closely to common usage, while permitting a useful operational distinction to be made.[2]

Differentiating between formal and informal training is a little more difficult. So far they have been tacitly distinguished by the location of the training and the degree of organization and supervision behind it. However, another useful measuring stick is the extent to which time, money and resources have been specifically allocated to the skill acquisition process - and in particular whether the function has a separate budget.

The two measures of formality will tend to coincide, but this will not always be the case. Thus a program could take place on the shop floor, with trainees involved in productive work and with no special instructor employed; and yet a specific amount of supervisors' and/or productive equipment time per day could be allocated for the purpose of instructing the trainees or allowing them to practice. In such cases, the psychologist or training officer will tend to define formality using the organizational criterion, whereas the economist will prefer the resource allocation criterion.

Substitutability of Skill Acquisition Methods.

Both the psychologist and the economist may object to the notion that formal and informal skill acquisition methods are complete substitutes. These will be considered in turn.

First, the psychologist may protest that informal methods, and especially learning from experience, are so much less efficient than formal procedures that they cannot be considered as valid alternatives. Thus one training text proposes "to limit discussion of training to ...formal programs" (McGehee 1961,

---

[1] The costs of learning from experience will involve loss of production through mistakes, spoilage and performance below the criterion.

[2] Machlup (in Robinson 1966, p. 694) makes a distinction between "training on-the-job" and "learning on-the-job without training" on the ground that "learning could only involve one person, the learner, whereas training required two as it also implied the existence of a supervisor or instructor." This would exclude self-instructional techniques from training, and will tend to cause ambiguity in situations where a supervisor is present. Machlup also implies here that "learning on-the-job without training" occurs without cost to the employer.

p. 3), and other "rules out all the hit-or-miss training and learning by chance that takes place on the job on a day-to-day basis" (Proctor 1961, p. 19). But this view considers only psychological efficiency and ignores economic considerations. Not surprisingly people will learn more quickly when they are individually tutored and provided with supervised graded practice, arranged according to their background, education and ability! But this can only be obtained at a cost, and the time saved may not justify the increased expenditure. Each case must be considered on its merits, and this cannot be done if informal methods are rejected automatically from the start.[1]

Second, the economist might object on the grounds that the costs of informal methods may be indeterminable and unavoidable, whereas formal training is undertaken by a deliberate decision and its costs are determinable. As mentioned in the introduction, Eckaus has suggested that on-the-job training is unavoidable during regular production, and that training and production costs are not completely separable. Similarly, Machlup (1962, Chapter IV) considers learning from experience, or on the job learning as he calls it,[2] to be part of the ordinary running costs of production. Yet why should it be assumed that informal skill acquisition costs are inseparable from production costs? There may be some difficult cases, but there should be plenty of instances where they can be readily estimated. For example, the costs of an operator increasing from 70 to 90 pieces a day in 5 days can be estimated by considering the loss of the 50 or so pieces that would have been produced by a skilled operator working at the criterion level. If a new engineer takes 2 hours to overhaul a component where the criterion is 30 minutes, the costs of his learning from experience can be estimated in terms of the overhauls "lost." Equally, a determination of the possibly disasterous effect of an inexperienced manager's mistake that halts production for a few hours, may well convince the company directors that management training is not quite so "costly" after all.

An informal skill acquisition up to the criterion can be avoided -- simply by placing a worker who already has the criterion level of skill in the job position. This may be done by putting the unskilled workers through a formal program which takes them up to the criterion level before placing them into production, or by recruiting skilled workers direct from the labor market. Thus, the decision to provide for informal skill acquisition can be a conscious and deliberate one.

The one significant difference between training and learning from experience is that the latter is liable to continue after the criterion has been reached, and this is, for all practical purposes, unavoidable. But it certainly is not costing the firm anything - the employee is performing at the criterion level for which he is getting paid. However, there will be a cost to the worker if the skill involved is general: as his skill increases so will his opportunity costs rise due to the difference between his marginal product and wages.[3]

---

[1] Educators in schools and colleges would also benefit from a consideration of the education value of learning from experience.

[2] I prefer the term 'learning from experience' since it is less ambiguous, and is a more general concept that can be considered as an alternative to all formal methods of education and training.

[3] The wise firm will match this by suitably timed wage increases, or promotions to job positions where a higher criterion level of skill is required.

But if the skill is specific there will be no opportunity costs to the worker, and a situation of completely costless skill acquisition would arise.

Optimal degree of formalization. The statements quoted at the beginning of this paper from general management and training offices may now be re-interpreted. It would appear that the "training is a luxury" attitude by management is not an objection to skill acquisition per se (indeed every firm that recruits from the labor market is inevitably involved in some skill acquisition); it is really an objection to allocating any resources specifically to it. It is equivalent to saying that informal skill acquisition methods are always more efficient than formal ones. On the other hand, training officers, equally dogmatically, seem to be advocating the reverse.

In fact, the degree of formalization will depend on various psychological and economic criteria. For example, complex skills requiring detailed instruction and supervised practice would demand more formal methods, while simple routine skills requiring little instruction but plenty of practice will tend to be acquired more efficiently by informal means. The educational background of the trainee is important: the high school drop-out is likely to respond more to informal techniques with no classroom activities - activities in which he was previously so unsuccessful - and where he can see the immediated relevance of what he is doing to a real work situation.[1] Similarly older workers may be reluctant to return to the classroom after many years of absence (see National Council on Aging 1966, pp. 372-376).

Economic factors such as the cost of making mistakes (and of course the general consideration of the likelihood of accidents) must be accounted for; as these two factors rise, the more necessary it is to have supervised training away from the shop floor. Other factors should include: cost and availability of classroom space, instructors, instructional equipments and materials, and the amount of idle time supervisors and equipment may have which could be used for training purposes.

* * * * *

Recruitment for skill. Thus one alternative to training is skill acquisition by learning from experience. However, there is another form of investment in human capital which is an alternative to any process of skill acquisition: to recruit directly from the labor market workers who already have the criterion level of skill. The term "recruitment" as used here covers the processes of SEARCHING the labor market for potentially suitable employees, and SELECTION from the results of the search those best qualified for the vacant job-positions.

Recruitment can be for "bodies" only, bodies plus certain aptitudes, and/or bodies plus certain skills. It is this third process of "recruitment for skill" which is substitutable for training - both have the objective of increasing productivity by increasing the skill level of the firm's labor force. It is important to distinguish between the productivity of the individual worker and the productivity of a job-position: although recruitment processes cannot affect a worker's productivity,[1] they can affect the productivity of a job position by influencing the level of human skill occupying it. And it is the productivity of the job-position that is the significant factor from the firm's point of view.[2]

---

[1] This is a principle reason why training under the Manpower Training and Development act 1962 has steadily shifted from "institutional" to on-the-job training programs.

Whether a firm undertakes recruitment for skill or provides for skill acquisition will depend on which results in lower total turnover costs (which arise from search, selection, relocation, training, classification, placement and separation of workers, as well as lost production through vacant job positions[3]). For example, if a skill is in abundant supply, it will usually be cheaper to recruit for it; but as the skill increases in scarcity, the search and relocation costs will increase to a point where it becomes cheaper to provide for skill acquisition. Again, as the cost of vacant job positions increases, training may tend to use more than recruitment since it could more readily ensure an adequate supply of skilled workers. Another factor, which will be considered in Part II, is that training may have a direct effect of reducing the turnover rate. Finally, the size of the firm will be significant: Foltman (1964) found that larger firms tend to prefer to train, while smaller firms find training "too expensive" and prefer to go to the labor market.

It should be noted that search and selection costs are almost always general investments in human capital since, by definition, for any particular firm there can be no specifically trained workers in the labor market - except for ex-employees of the company.[4]

* * * * *

Investment in physical capital. A final alternative to training, or any investment in human capital, is to invest in physical capital. That is, when faced with a shortage of skills, to obtain equipment that operates automatically or only requires skills that the firm already has in its labor force.

To summarize Part I: when faced with skill requirements, a firm could provide for a formal training program. However, there are three alternatives:

---

[1] This is not strictly true. Information gathered during a careful selection process can facilitate the worker being placed in a job-position where his productivity will be a maximum.

[2] Oi (1962, p. 539) makes a misleading distinction between recruitment and training on the grounds that only training can affect the productivity of the individual worker. Mincer (1962, p. 51) also refers to training as any investment (in human capital presumably) which increases "worker productivity."

[3] See Gaudet (1958, p. 31) for a discussion of turnover costs (but which fails to consider vacant job-positions).

[4] Rare exceptions could occur when there are persons in the labor market with, by change, a certain combination of skills (including personality traits) that are specific to one firm only. The search costs here would tend to be very high.

1. Provide for informal skill acquisition, including learning from experience
2. Recruit for the skill
3. Invest in physical capital.

II. BENEFITS AND COSTS

Any rational decision on undertaking training should take into account the relative benefits of all three alternatives identified in Part I and there will be an optimum combination of these alternatives that could provide for skill requirements - given a certain product, level of output, and labor market. The difficulties of determining such a combination are not to be minimized, but the disturbing thing is that the training profession hardly seems to be aware that such an approach is needed.

However, this is jumping the gun somewhat since, as was indicated in the introduction, there appears to be a complete absence of any quantitative cost-benefits analyses within the industrial training field,[1] let alone any comparative studies. Therefore as a first step this Part will discuss the nature and measurement of costs and benefits of training, and will critically review the present situations. However, an outline of a cooperative study of training and recruitment for skill will be included.

Benefits. The training texts usually list an impressive array of alleged benefits of training. A typical selection is given by Proctor (1961, p. 23):

increased employee satisfaction
less waste and spoilage
lower absenteeism and turnover
improved methods and systems
increased level of output
less supervisory burden
lower overtime costs
lower machinery maintenance costs
fewer grievances
lower personal injury rates
better communications
greater employee versatility
improved morale
greater cooperation

This is simply an interesting "common-sense" list of plausible hypotheses, with no systematic evidence to back them up or to determine the extent to which each operates.[2] It would be very difficult to find operational measures for some of the benefits; and to determine the contribution of each would involve lengthy and costly controlled experiments (although they would provide useful information on the mechanisms by which training contributes to increased efficiency). In short, lists such as the one just quoted, are not likely to prove very useful in obtaining a measure of benefits in dollar terms.

---

[1] That is, analyses with respect to the firm. There have been analyses made with respect to society.

[2] Many of them could also be benefits of informal skill acquisition, recruitment for skill, or the installation of improved equipment.

What is required is an aggregate measure which will capture all or most of the alleged benefits of training, and which is relatively easy to assess in dollar terms. The most useful measure would appear to be based on the cost of production, at least for measuring effects on the individual worker, production section or department. The measure would be more difficult to apply to a unit larger than a department where the many variables affecting production costs would tend to mask the effect of training. However, most training is organized on a departmental or 'lower' basis.

Where a training program is designed to have a more "diffuse" effect speeading over many departments, supplementary maasures of benefits may have to be employed. Thus the benefit of supervisory training might be measured in terms of savings through the elimination of delays in inter-departmental shipments or servicing, or through the reduction of paper work and communication costs. Also when a program has a very specific objective, such as the reduction of spoilage or of overtime worked, the benefits can usually be measured directly in terms of that objective.

It will be noted that a number of the alleged benefits of training listed above are concerned with employee satisfaction and "morale." And some of the effects of this, in the form of decreased turnover, may not be fully captured by using only the costs of production measure. This would be particularly important in comparative studies since the morale effect is not so likely to result from the alternatives to training.[1]

A second reason why turnover may be a useful operational measure is that a training program can operate as a selection procedure of high validity. The employer can observe the trainees' typical performance over a period of time under conditions related to the final work situation, and the trainee will get a good insight into the nature of the job and decide if he really wants it. Hence trainees that stick with the program to the end and are finally accepted by the firm, are probably better "bets" than directly recruited men that have been put through a battery of achievement and personality tests of perhaps doubtful validity.[2]

To summarize, two operational measures of benefits suggested here are (1) cost of production and (2) turnover.[3] However, where training has particular objectives, it may be evaluated directly in terms of those objectives; and where the benefits are expected to be diffused over several departments, supplementary measures should be used.

---

[1] The Hawthorne effect may be operating in training, whereby employee satisfaction (and production) tends to increase when the employees feel the company is taking an interest in them.

[2] K. U. Smith (1965) considers much of industrial testing to be invalid.

[3] Care must be taken not to double count benefits when using more than one measure.

In passing, one might speculate that it is not surprising that some hard-pressed managers regard training with suspicion when the benefits are classified in such nebulous terms as: better communications, increased employee satisfaction and greater cooperation!

Costs. The measurement of training costs has not progressed much further than the measurement of benefits. It is true that there are some published estimates (see Part III), but there is considerable doubt as to the validity of the accounting procedures used. For example, "the salaries of newly hired trainees are treated as educational expenses; those of employees participating in advanced training programs are not... Such intricacies of accounting compound the difficulty of measuring the cost of education in business" (DeCarlo, 1966, p. 24). A survey of British firms on methods of costing training showed "a wide variety of practices based on differing criteria" (Institute of Personnel Management 1965). Similarly, because much of informal training costs tend to be hidden in production costs, Mincer (1962, p. 52) notes that "data on costs of training ...are not only scarce, but in principle highly unreliable."

It appears that training cost data and budgets, where they exist, are set up more for internal administrative convenience than for the purpose of estimating real costs. And since none of the published data give any breakdown as to how the final figures were arrived at, little reliability can be placed on them.

The estimation of direct costs such as instructors and trainee salaries and cost of instructional materials should present little difficulty, although care must be taken to recognize opportunities foregone - if any - in the use of classroom space and production equipment. Indirect costs of the more informal methods will be more difficult to estimate, and will arise from: mistakes and spoilage, increased supervision and inspection, and in general the loss of production due to the diversion of human and physical resources to non-productive training activities. Again, it is important to recognize that when the production schedule is slack or intermittent, opportunity costs of shop floor training could be very low since supervisors and machines may otherwise be idle.

In order to determine the net costs of an investment, the value of "immediate benefits" should be subtracted from gross costs. By far the most significant immediate benefit of training is the productive work of the trainees, allowing for the fact that they are usually paid at a lower rate than fully skilled workers during the same job; and this benefit can sometimes reduce the net costs to levels very much lower than gross costs, and sometimes even to zero.[1] Another immediate benefit could arise if recruitment - and particularly search-costs - were higher for skilled workers than trainees.[2] Finally the value of training as a highly valid selection procedure could be estimated by determining the costs of a battery of tests and interviews etc. of equal validity; or alternatively by how the increased validity of selection could reduce production and turnover costs.

---

[1] Oi (1962, p. 546) surely did not allow for productive work of apprentices when he indicated that one U.S. firm "invested" around $4600 a year in each apprentice. Net estimates for European apprentices range from $300 to $1250 a year (see Part III).

[2] One proposed apprentice training scheme (BASIE 1965) omitted any reference to recruitment costs of skilled workers, yet included recruitment costs of trainees on the debit side of the account. The significance of such an omission is shown by one estimate of $800 for the difference in search costs between journeymen, machinists, and unskilled workers (Gaudet, 1958).

In conclusion, it might be interesting to speculate on how the faults of existing cost procedures could bias the present estimates of training costs. One might hypothesize that the costs of formal training are overestimated due to factors such as: accountants use of average as opposed to marginal techniques, the failure to recognize the costs of alternatives (e.g., direct recruitment), and the desirability of overestimation for departmental budget and taxation purposes. On the other hand, informal skill acquisition costs may often be underestimated or completely unrecognized since they tend to be hidden in production costs. Thus Mincer (1962, p. 52) concludes that "an attempt to gauge costs of on-the-job training in the economy by accounting data of firms, even if they were available, would lead to severe underestimation."

Such a hypothesis throws more light on the attitude of the "anti-training" manager. He is only too well aware of the, possibly overestimated, costs of formal training; but may be quite unaware of the nature or magnitude of the costs of informal skill acquisition procedures.

Relative benefits of recruitment for skill. The benefits of both recruiting for skill and training will tend to be similar (higher productivity, less spoilage etc.) except for the lower turnover rate that might be expected from training, due to the Hawthorne or moral effect and the high selective power of a training program. In addition, the lower search costs and smaller number of vacant job positions that might result from training would also be captured in measure of total turnover costs.

Hence a very useful comparison between recruitment and training could be made by measuring the effect of each on total turnover costs. And this could conveniently be carried out by measuring turnover costs before and after a training program was introduced; turnover costs before the program would measure the effect of recruitment for skill, and turnover costs incurred while the program was operating would measure the effect of training. A number of such studies might allow a relationship between the relative benefits of recruitment and training to emerge, depending on factors such as: the labor market, complexity of the skill, size of firm, and cost of vacant job-positions. This would have considerable practical significance since, as will be indicated in Part IV, a major factor in decisions on training should be the relative benefits of the alternative form of investment in human capital, recruitment for skill.

It is possible that the effect of training on turnover is relatively small - in which case matters would be further simplified as, to a first approximation, only the difference between the costs of recruitment[1] and training would need to be measured since the benefits would be assumed equal.

---

[1] The costs of recruitment should be relative easy to assess, and will arise from advertising and personal contacts, interviews and tests (see Gaudet, 1958).

III. TIME AND UNCERTAINTY

For the firm, there is a major difference between human and physical capital in that the time period over which returns to the former can be collected is relatively uncertain. Unlike physical capital, the firm does not own the human capital it invests in, and can lose it at any time simply by the worker concerned terminating his employment.

This danger is greatly increased when general skills are involved since the competitor firms may attempt to recruit the generally trained workers away from the firm that trained them, the so-called "poaching" operation. Indeed it is widely believed that this poaching complex is the main reason why firms are reluctant to invest in training - as is shown by the passing of the British Industrial Training Act, 1964. Briefly, firms must pay a levy according to the size of their payroll, and they receive grants according to the amount of approved training they undertake, if any. It has been noted that "the grant system is really a gigantic national device for spreading the costs of training evenly over all employers in proportion to the size of the labor force of each. This is referred to as the 'Redistribution of Costs' aspect, and, quite obviously, is aimed at the poaching complex." (Wellens 1965).

Uncertainty and rational action. Faced with this situation of uncertainty as to how long the employee will remain with the firm, how should a rational firm behave with regard to investment in human capital? Becker (1964) has proposed a theory based on general and specific investments. General training, it will be recalled, is equally applicable to the training firm and at least some of its competitors and therefore will raise the workers' marginal product by an equal amount in all those firms. However, specific training is only applicable to the training firm, and hence it will only raise the workers' marginal product in that particular firm.

At the end of the training period, a specifically trained worker is "tied" to the firm if he wishes to use his skill, while a generally trained worker can leave and use his skill in a competitor firm. Assuming perfect labor markets, Becker argues that a firm will only undertake general training if the trainees pay directly or indirectly for the total cost,[1] since there is no guarantee they will remain with the firm after training; but a firm may be willing to pay all or part of the costs of specific training since the worker will have an incentive to stay because his specific skill will only be to his advantage in that firm. In the case where the costs of specific training are shared between the firm and the trainee, both will recoup on their investments by the trainee remaining - he will receive higher wages than he could elsewhere, while the firm can still pay him less than his marginal product.

Thus firms do not invest in "general" training, they merely provide for it - only workers actually invest in it. And even with specific training, the wise firm will pass some of the costs onto the trainee to give him an incentive to remain after training in order to recoup on his investment.

Becker's theory logically follows from the assumptions of perfect labor markets and rational profit-maximizing behavior of firms. However because of the nature of these assumptions it is open to criticism on the grounds of lack of relevance and realism; R. C. Eckaus (1963) has questioned the ability of the theory to "provide reasonably accurate descriptions of reality and good predictions," in particular because of the strict dependence on perfect labor markets. I would agree with this comment, and I believe the theory can be made more useful by dropping the assumption of perfect labor markets and recognizing mobility friction.

---

[1] Payment will usually be made in the form of foregone earnings - where the trainee does productive work equal to that of a fully trained worker, but at a lower wage rate.

Indeed, I will argue that the basis of a rational decision on investment in human capital is not the generality of the skills, but the mobility potential of the trainees. In reality, a firm would be unlikely to undertake any training, general or specific, if it knew for certain that all trainees would leave at the end of the training period.[1] Equally, a firm may well willingly invest in training, general or specific, if it knew for certain that all the trainees would stay after the training period. Of course, one of the principle determinants of the future mobility of trainees will be the degree of generality of the training; but the point is that mobility potential of the trainees is the basic criterion for investment decisions, and it can be influenced by other factors such as geographical location and trainee personality. Thus a firm controlling a "one-company town" could invest in general training since its trainees would tend to have a very low mobility potential; while a firm in a large city would probably not provide any training, general or specific, for persons whose past employment record shows a high mobility potential (e.g., 10 job changes in 3 years). Another personality factor might be the degree to which the trainee feels "grateful" for the training period. Thus a firm could find that with a certain type or trainee, it can rely on a sense of moral obligation by which the trainee will stay long enough for the firm to recoup on an investment in general training.

Another very significant factor that could be accounted for in a measure of mobility potential is the extent of the trainees' previous investments in specific training. If this is high, the firm could safely finance some general training, since the trainee would still have an incentive to stay on to recoup on his previous specific investments. An example could be when senior personnel are sent on expensive external courses attended by members of competitor firms (which must therefore be general training courses).

Another point not included in Becker's analysis is the almost inevitable general investment in human capital a firm must make when recruiting new workers (except when they are ex-employees of that particular firm). If total turnover costs are reduced, and investment in general training will be justified (see Part II).

To summarize: faced with the uncertainty of retaining its investment in human capital, a rational investment decision for the firm must be based on the mobility potential of the trainees. The principle determinant of this mobility will be the generality of the training, but other factors (such trainee personality and health, and geographical location) could significantly influence it. In addition, account must be taken of the almost inevitable general investment in human capital whenever a new employee is recruited.

---

[1] Unless the firm deliberately decided to make a profit on the activity by using the trainees as cheap labor.

Testing the theory. Becker's theory, with or without the modifications suggested above, is not easy to test due to the difficulty of measuring the degree of generality of the training - quite apart from the problems of determining the training costs and their distribution between the firm and trainee. However, a somewhat simpler, yet useful, study could be conducted on a training program which was assumed to be completely general. And I believe apprenticeship schemes could provide an example of such a general program.

Traditionally, workers are apprenticed to a trade as opposed to a particular firm, and many apprenticeship programs claim to provide general "all round" training in that trade. Indeed, some programs appear to be becoming even more general: European trade unions are "encouraging a trend towards broad and basic training valid for a number of specializations," and apprenticeships have "increasingly taken on the role of a system of work-orientation for out-of-school youth" (CIRF, 1966). A study of U.S. machinist apprentices indicates that the programs provide broad training applicable to a wide variety of industries (Koerble 1954).

In the U.S. and most European countries minimum training standards and requirements are often laid down covering a whole industry, and are not specific to one firm. The U.S. Bureau of Apprenticeship and Training will only register an apprenticeship scheme if "training is applicable throughout an industry, not unique to the manufacturing requirements of one company."

Of course, there will be apprenticeships that tend to provide specific training, especially perhaps in smaller firms where "programs are often too narrowly determined by the immediate rqquirements of the undertaking" (CIRF, 1966); but these firms should not be much of a problem since they would be unlikely to want to cooperate in a study, or publish details of their schemes. In addition, there will be, legitimately, some degree of specificity in all in-company programs. Nevertheless, within these limitations, apprenticeships can be regarded as a useful source of data on general training. And they have the additional advantages of being long (2-5 years), therefore involving considerable amounts of money, and they are given to employees with no previous specific training.

Ideally, the study should be on a program which conforms to these conditions:

1. is in an industry which lays down strict industry-wide standards, and in a firm which claims to adhere to these standards
2. where free access is available to the classroom shop floor so that:
   - i. adherence to the standards can be checked[1]
   - ii. costs can be measured directly (as opposed to being obtained from the firms accounting data)
   - iii. benefits can be identified and measured
3. has been operating for a number of years so that the mobility potential of the ex-apprentices can be determined (by the percentage retained), and so the influence of the training on total turnover costs may be estimated
4. in a firm which keeps records such that total turnover costs before the training program was introduced can be estimated, thereby determining the relative benefits of training over recruitment (see Part II)

---

[1] Other methods to check the generality of the program would involve the amount of training competitor firms have to give ex-apprentices, or the starting wage these firms are prepared to offer.

If step 2 (ii) showed the net cost to be near zero, then Becker's theory would be supported since the firm would not then have financed general training. If the costs were positive, then a determination could be made as to whether the apprentice mobility, and/or any reduction in total turnover costs, justified the general investment in human capital.

Policies and attitudes of firms. A survey of the apprentice training literature was made to determine present policies and attitudes of firms to an investment in general training. In several of the quotations listed below, the firm has given an estimate of its training costs but no indication of how they were arrived at. Therefore from the previous discussion on training cost data, they must be regarded as unreliable (in all probability the net costs are considerably lower than the estimates and, if Becker is correct, may even be zero). However the firms apparently believe that the general apprentice training is costing them this money - which is equally significant.

i. A large German firm manufacturing electrical equipment estimates, after a careful study of all the factors involved, that the overall net cost amounted to close to $500 per annum for each apprentice in 1959. (CIRF 1966)

ii. German experts...say that the three years wholetime professional training of an apprentice at present costs 3,000 to 5,000 DM ($750 to $1,250). The days when an apprentice was nothing but cheap labor and financial profit have passed. (Abraham 1966)

iii. A metal trades apprentice who receives broad general training is a charge to the undertaking at least during the first two years. If the margin between the pay given the apprentices and the wages paid to adult workers doing the same job and the training period is long, the apprentice may, in the third and following years, pay back some of the net expenditure incurred during the first two. Apprentices in highly skilled trades, who must receive intensive instruction in a broad range of skills and make costly errors may during the apprenticeship constitute a net charge to the undertaking even when the training period is long. (CIRF 1966)

iv. In one firm "apprentices perform regular production work, making apprentice training almost self-supporting." (National Industrial Conference Board, 1937)

v. United Kingdom studies (1962-63) suggest a net cost per apprentice in the metal trades of around $300 per annum. (CIRF 1966)

vi. Up to now we have been spending $100,000 a year on apprentice training. Many of our former apprentices have gone to other firms who have been able to afford the bait of more money because they have not been spending anything on training schemes. (Mather 1966)

Thus some firms apparently believe they have decided to invest in general training. This decision could only be rational if the firms were relying on mobility friction to retain at least some of the trainees. The last quotation, which comes from the chairman of an engineering group, illustrates the attitude very nicely. Even though "within a few years, 40% of these lads are pirated away by other firms" Mr. Mather's group still manages to retain 60% - in spite of the fact that they could get higher wages elsewhere. 60% of the apprentices retained over many years at less than the market wage could bring quite a nice return on the (overestimated) \$100,000.[1]

IV. IMPLICATIONS FOR LEGISLATION ON TRAINING

"Since every company is going to benefit from the availability of competent labor, every company should participate in the training of that labor." (National Industrial Conference Board 1937).

It appears that many firms, in Europe at least, have not been following the ethical dictates of the above quotation, and that legislation has been enacted to alleviate the situation - namely the British Industrial Training Act, 1964, which is a forerunner to similar legislation for the European Common Market. The Act requires that Industrial Training Boards be set up for each major industry, or group of industries, which will impose a levy on all firms in that industry and will make grants to firms undertaking approved training programs.[2] So far about 30 Boards have been set up, or are in the process of being organized, covering industries such as Engineering, Iron and Steel, Hotel and Catering, Civil Aviation, Carpeting, etc.; and each Board has very considerable autonomy in determining its levy/grant system according to the needs of each particular industry. However, only a few have so far become operational, and it is the policies of these Boards that will be discussed here.

A number of points will be raised in the discussion which have not been accounted for in the Boards' policies. However, it is appreciated that the Boards have a very difficult task in formulating policy in an area where quantitative data on costs and benefits is so scarce and unreliable; and in any case it would be surprising if all the issues raised in an analytical discussion could be immediately incorporated into a practical policy. The criticism offered here is not so much that many of the difficulties and ramifications remain unaccounted for, but that - judging from the literature - quite a few remain unrecognized.

Specificity of training. No distinction has been made between general and specific training.[3] The levy is imposed on all firms according only to the size of the payroll and regardless of skill requirements; and the grant is paid to all firms undertaking approved (in terms of quality) training regardless of the applicability of the skills to other firms in the industry. From our previous analysis there would appear to be little need to encourage specific training since there is no danger of poaching by other firms.[4]

---

[1] Assuming net training costs of \$100 p.a. (quotation iv above); a training period of 5 years; that the ex-apprentices are paid \$2 per week less than the market rate; that 40% stay for 2 years and 60% stay for 15 years; then the internal rate of return on the investment is approximately 8%.

[2] The Boards may also set up their own training programs, but the initial emphasis has been on the levy/grant system. For a useful summary of the legislation see Wellens (1965).

[3] The terms "general" and "specific" will remain, as defined earlier, with respect to the firm, and not with respect to the industry.

[4] It might be argued that in a very tight labor market, labor mobility could be so high that it would not be economical to invest even in specific training.

In fact, firms investing in specific training will tend to get a "double pay-off" from the levy/grant system - not only will they receive a direct return to the investment, but they are also paid a grant toward the cost of that investment. It could be argued that the levy paid by these firms will tend to balance the effect of the grant, but this would only be so if they had little or no general training requirements. And this will not always be the case -firms requiring specific skills will often need general skills on which to base them.[1] In addition, firms undertaking a greater than average amount of training will receive grants in excess of the levy they pay, and highly specialized firms requiring high levels of specific skills could tend to be in this category.

Thus firms investing in specific training will tend to be subsidized by the rest of the industry, and in cases of highly specialized firms this subsidy could reach significant amounts. Although the eventual solution of the problem will depend on the development of a sophisticated measure of specificity of training, the Industrial Training Boards could surely be on the lookout for any obvious cases of gross inequalities caused by some firms investing heavily in specific training?

A related problem, of course, concerns the firm that has little or no skill requirements. They still have to pay the levy, but cannot receive a grant since they cannot usefully undertake any training. This could be very serious for the firm employing a relative large unskilled labor force since the levy is based on the number of employees.

Benefits of training. The most severe criticism of the Training Boards' policies is their emphasis on training costs alone, as opposed to a consideration of both costs and benefits. The failure to distinguish between general and specific training is an example - it is really a failure to account for the difference in benefits of the two types of training.

Similarly no account has been taken of potential labor mobility.[2] Thus a firm in an isolated area will tend to gain more from the grant system than would a firm in a heavily industrialized area. The consequences of this will be particularly important in industries where some, but not all, the firms are concentrated in centers. An example is to be found in the Iron and Steel industry: numerous firms are concentrated in the city of Sheffield in the North of England, but there are two very large companies that dominate small towns in Wales and Scotland with no other steelworks in the area. A possible solution here would be the establishment of "Sub-boards" for particular geographical areas.

The general emphasis on costs alone is shown by the approach of the Boards to the payment of grants. Thus the Engineering Industrial Training Board "found it impossible to base grants in the first year on audited training costs,[3] as originally planned, and instead calculations would be based on the actual number of trainees and a performance rating on the quality of the training they received" (Institute of Personnel Management 1965, p. 10). Thus the Board considered that ideally grants should be directly proportional to costs, and when this proved impossible they still chose a criterion based solely on the inputs to training, with no regard for benefits. This view is also shared by members of the training profession: for example, small firms "have a right to expect repayment of the costs in full out of the levy" (Wellens 1966, p. 197, my emphasis), and the supervisory training grant/levy scheme should be "based on pure cost" (Institute of Personnel Management, 1965, p. 11).

---

[1] An example would be a steelworks producing special alloys; they would require the general skills common to all steel works plus the specific skills appropriate to the particular alloys being produced.

[2] A comprehensive measure of this could also account for the specificity of the training (see Part III).

[3] Due to the unreliability of firms accounting data.

Statements such as these create a disturbing suspicion that even in the high places of those intimately concerned with the policies of the Boards, training has not been recognized as an investment with both costs and benefits, but is regarded simply as an expense with costs only.

A grant system based solely on costs would also have the disadvantage of encouraging inefficient and unnecessarily expensive training programs. And firms that are not really in a position to undertake training economically (e.g., small firms) will be tempted to do so if their costs are to be fully covered by a grant. Thus, from this view, the Engineering Board's "second best" criterion of using the quality of training as the basis for grants will be better than using costs - even though again benefits are not considered.

Alternatives to training. (1) Informal skill acquisition. There is a danger that the Boards will concentrate on formal training programs for two reasons: failure to recognize informal skill acquisition procedures as valid alternatives, and the difficulty of costing the more informal methods. Some Boards are basing grants on factors such as the number of instructors, classrooms, overhead projectors, teaching machines and other "gadgetry" associated with formal training;[1] such policies will inevitably cause skill acquisition procedures to become more formalized even though in many cases this will result in increased costs. And no account has been taken of learning from experience - partly because the firms that wittingly or unwittingly provide it may not themselves recognize that they are in the "skill acquisition business." In short then, the Boards' concern may tend to be limited to formal training as opposed to skill acquisition as a whole. (2) Recruitment for skill. The relative benefits of recruitment and training have also been ignored. This is singularly unfortunate since the principle purpose of the grant system should be to direct firms' activities away from recruitment for skill, and towards training. Indeed, in the next section I shall argue that the relative benefits of the two activities could form the basis for the payment of grants. (3) Investment in physical capital. The effect here will tend to vary. It will encourage investment where the total number of employees is reduced (hence reducing the levy), and/or where the amount of specific training needed is increased (hence increasing the grant). But it will tend to discourage the purchase of equipment which decreases total skill requirements without a relative decrease in the number of employees. However, the dominant effect will probably be to encourage investment in automated equipment, which tends to significantly reduce total labor requirements.

---

[1] However, in its second year the Wool Board began giving grants for "sitting next to Nellie" training methods.

In any case, the Boards should at least be conscious of that their policies could influence investment in physical capital, and perhaps be prepared to consider awarding grants for new equipment that would release generally skilled workers for employment in other firms in the industry.

Proposed basis for the levy/grant system. First, the principles behind the proposal will be outlined, followed by a consideration of their practicality:

The LEVY should be based on general skill requirements (as opposed to the size of the payroll). Thus firms with only specific, or not skill, requirements would not be included.[1]

The GRANT should be based on the relative benefits of general skill acquisition procedures and recruitment for those skills (as opposed to the absolute cost of training).

Skill shortages can be created by firms quite rationally preferring to recruit for skill than training, since they find the former activity cheaper. The basis mechanism of the grant system should be to divert efforts away from recruitment and towards training - to cause some firms to initiate or expand their training to a point where the skill shortage is eliminated.[2] It probably would not be desirable to have all firms training, but only those that can do it most efficiently - under the proposed system some firms would still find it cheaper to recruit.

Under the present system of basing grants on costs of inputs only, firms already receiving an economic return on their general training would get the same grant as those firms that previously could not train because of high trainee mobility. If recruitment costs were calculated for each firm, or for a geographical area, this advantage would be reduced or eliminated. And even if initally, calculations were based on a national average recruitment cost estimate, the grants all round would be less than they are at present, and hence firms that cannot undertake general training would be subsidizing to a lesser extent those that already have economical programs.

Obviously, these proposals would not be immediately practical with so little known about the costs and benefits of training and recruitment,[3] and in the absence of a measure of skill specificity - and an extensive amount of ground work would be needed to gain this knowledge. Nevertheless, a start could be made by concentrating on a few common general skills and carrying out an intensive series of cost/benefit analyses on training and recruitment for them (apprenticeships skills would be an obvious example). The implication here being that instead of jumping into a complete national levy/grant system covering all firms and all skills, the Boards might have done better to confine themselves to a few general skills on which to gain their initial experience - and it is precisely these important skills required by many firms, which are most in need of an effective levy/grant system.

---

[1] In its second year the Wool Board halfed the levy paid by firms with no skill requirements, which is a step in the right direction.

[2] With extremely scarce skills this mechanism would not operate, since recruitment costs would be so high that simply giving a grant to reduce training costs below recruitment costs would not be sufficient to cause firms to train. In such a case the full costs of training should be granted, at least until the skill becomes less scarce.

[3] A method for comparing the relative benefits of training and recruitment was outlined in Part II.

Indeed, I would seriously propose that in the first year or so of a Board's operation, grants should be given on the basis of the extent to which firms carry out evaluative and cost/benefit studies on their recruitment and training programs. If the results were then circulated to the other firms in the industry, all would gain useful information in return for their levy, and the Board itself would have a sound basis for formulating future policy.

Finally, the policies of the Wool Industrial Training Board emphasizes the need for groundwork. They are in the fortunate position of inheriting the experience of a committee on training problems in the Wool Industry that had been operating for some years. Yet in spite of this basis - or rather perhaps because of it - the Board has deliberately moved cautiously over the first two years, using a relatively small levy and widely applicable grant-giving criteria. And it is only the Wool Board that has so far introduced a differential levy for firms with no skill requirements, and that has recognized "sitting by Nellie techniques."

Knowledge. Up to now it has been assumed that firms have been acting rationally on full knowledge of the returns to training, and that they have not been investing in it because the returns have been inadequate, or because returns to the alternatives to training have been greater. However, the quotations given in this paper concerning the attitude and policies of managers and training officers indicate that they are far from aware of the nature of the returns to training.

Thus an extremely important function of the Training Boards should be the collection and dissemination of data on cost/benefit analyses on training and its alternatives, and the development of techniques for carrying out such analyses. Again the suggestion of initiating a series of analyses on a few common general skills would be an excellent way ofobtaining such knowledge. Indeed, once firms become aware of the potentialities of training, the Boards may find that much of their work will be done for them.

Conclusion. Some Industrial Training Boards appear to have jumped into the establishment of national levy/grant systems without recognizing some of the problems and ramifications. In view of the present lack of knowledge and data on the economics of training, the Boards have inevitably made some arbitary decision -- in fact, at least one has been accused of sheer arrogance. It is suggested here that the Boards' direct their activities to the more immediate and limited aim of laying some groundwork, which could be done by initiating an intensive series of cost/benefit analyses on training and recruitment for a few important general skills.

This paper has outlined an approach to such cost/benefit analyses, with particular emphasis on the time period over which the benefits may be realized. The main thesis has been that in order for a firm to develop a rational policy concerning its skill requirements, it must estimate the net costs and future benefits of any training it may undertake, and make comparisons with alternative investments in informal skill acquisition prodedures, recruitment for skill and physical capital. Few firms have begun to think in such terms.

Abraham, K., "Technical Education" in Robinson E.A.G. and Vaisey, J.E., "Economics of Education", New York: St. Martins Press, 1966.

Al-Arabi, Mr., "Experience of Apprentice Training in the United Arab Republic," International Labour Review, December, 1965.

BACIE (British Association for Commercial and Industrial Education) "A Standard Method of Costing the Training of Apprentices," London, 1965.

Becker, G.S., "Human Capital," New York: Columbia University Press, 1964.

CIRF Publications, "European Apprenticeship," International Labour Office, Geneva, 1966.

DeCarlo, C.R., and Robinson, O.W., "Education in Business and Industry, New York: Center for Applied Research in Education, 1966.

DePhillips, F.A., Berliner, W.M., and Cribbin, J.J., "Management of Training Programs," Homewood Illinois: Richard D. Irwin, Inc., 1960.

Eckaus, R.C., "Investment in Human Capital: A Comment," Journal of Political Economy, October, 1963.

Foltman, F.F., "Apprenticeship and Skill Training - A Trial Balance," Monthly Labor Review, January, 1964.

Fryer, H.F., Fennberg, M.R., and Zalkind, S.S., "Developing People in Industry," New York: Harper & Brothers, 1956.

Gaudet, F.J., "Calculating the Cost of Labor Turnover," Personnel, Sept.-Oct., 1958.

Institute of Personnel Management, "Costing the Training Function," London, 1965.

Koerble, C.E., "Appraisal of Machinist Apprentice Training," unpublished Ph.D. dissertation, University of Wisconsin, 1954.

Machlup, F., "The Production and Distribution of Knowledge in the United States," Princeton, New Jersey, Princeton University Press, 1962.

Mather, W., The Guardian, London, December 15, 1966.

McGee, W.A., and Thayer, P.W., "Training in Business and Industry," New York: John Wiley & Sons, Inc., 1961.

Mincer, J., "On-the-Job Training: Costs, Returns and Some Implications," Journal of Political Economy Supplement, October, 1962.

National Council on the Aging, "Manpower Training and the Older Worker, 1966.

National Industrial Conference Board, "Training for Industry," New York, 1937.

Oi W.Y., "Labor as a Quasi-Fixed Factor," Journal of Political Economy, December, 1962.

Proctor, J.H., and Thorton, W.A., "Training" New York: American Management Association, 1961.

Robinson, E.A.G., and Vaisey, J.E., "Economics of Education," New York: St. Martins Press, 1966.

Smith, K.U., "Cybernetic Analysis of Psychological Testing and Testing Systems," Behavioral Cybernetics Laboratory, University of Wisconsin, 1965.

Wellens, J., "Britain Adopts a New Training System," Training Directors Journal, October, 1965.

Wellens, J., Editorial, Industrial Training International, August, 1966.

SOCIAL SYSTEMS RESEARCH INSTITUTE
UNIVERSITY OF WISCONSIN

WORKSHOP ON ECONOMICS OF HUMAN RESOURCES:
PAPER 6605

WISCONSIN'S WORLD WAR I EDUCATIONAL BENEFITS FOR VETERANS: A HISTORY OF A UNIQUE EDUCATIONAL EXPERIMENT

BY

ALLEN VAN POTTS

November 30, 1966

"I feel that the greatest bargain that we have achieved since the Louisiana Purchase was the passage of the GI bill of rights."--
Senator Lee Metcalf

This seemed to represent the consensus which secured the recent extension of the GI bill to Cold War Veterans. That extension reopened the book of the colorful history surrounding the passage of the original GI bill. Time has unfortunately dimmed many of its aspects. Its whole history would have been vastly altered for instance, if the Osborn Committee, which was established by President Roosevelt in 1942 to examine the question of Federal Aid to veterans for education and training, had had its way. That committee was so overwhelmed by what a few States had been able to accomplish for the World War I veterans in the face of Federal ineptitude, that it strongly recommended that the Federal Government merely backstop the States in their efforts to provide educational opportunities for the veterans, as they had traditionally done. This factor was highlighted during the hearings on the education bill in an exchange between Senator Claude Pepper of Florida and Colonel Francis Spaulding, Chief of the Army's Morale Service Division (representing the Osborn Committee):

> Col. Spaulding. I think it is fair to say the committee had in mind continually that the young people who have gone into service are still the sons and daughters of their States and that the States are not likely to leave those young people completely in the lurch.
>
> Sen. Pepper. Did the States make any provisions for vocational education or college training of their boys after the last war?
>
> Col. Spaulding. Yes, some of them, very liberally. Wisconsin provided much more liberally than the Federal Government and is still providing for its young people and the descendents of those people.

Sen. Pepper. To go to college?
Col. Spaulding. Yes, sir.
Sen. Pepper. How many other States did that?
Col. Spaulding. I do not know the exact numbers.[1]

A careful purusal of all hearings and debates on the GI bill failed to disclose that anyone else was interested in what had previously been accomplished along these lines. Quite the contrary. Mr. Colmary, past Commander of the American Legion stated to the House Committee that: "This nation has never before been confronted by this problem (of educational aid for veterans). Frankly, I learned that in discussing that with Senator Thomas and Mr. Barden of your body, and others, as they have approached this problem."[2]

It was indeed unfortunate that the Wisconsin World War I "doughboy bill" was not carefully examined in the hearings and debates, though it is almost certain that it received some attention by the staffs of the various committees working on the GI bill. The Wisconsin bill was brilliant in its concenption and far-sighted in its execution. Had its example been followed, the Federal Government could have saved hundreds of millions of dollars and a great deal of time and difficulty for itself, the States and the veterans. The Korean GI bill, which was designed to cure the abuses and administrative difficulties inherent in the World War II bill, closely resembled it.

It is in the belief that the Wisconsin experience can still prove beneficial to those organizations contemplating government payments to individuals as an inducement to further their educational attainments, as well as to preserve more of the history of veteran's educational benefits in the United States, that the following history of the Wisconsin World War I Education Bonus and its background are presented.

BACKGROUND OF THE WISCONSIN BILL

The Biennial Survey of Education by the Department of the Interior for 1920-1922 called attention to the fact that after every major war fought by the United States has come a renewed emphasis on education. After the Revolution, the Federal Government came into possession of vast amounts of land, from which it made generous grants to the States for the foundation of public education. After the Civil War, public school provisions in the constitutions drafted by the newly created States testified to the increasing social consciousness and its faith in education.

The Survey prophesied that the effects of World War I upon education in the United States would be as far-reaching and important as those which had come out of previous wars. It also noted that the Federal census of 1910 as well as many other national and State reports had tried to awaken the country to the ". . . shocking extent of illiteracy, the failure of the States to make education universal, and the disasters awaiting American democracy if measures so inadequate were to continue."[3]

At the height of this reawakened concern for education the Office of Education in 1917 published a bulletin entitled The Money Value of Education, which "is one of the most widely quoted studies on the relation between education and income." This study showed that a high school graduate earned twice as much money in a lifetime as an uneducated laborer, and that it was education that had made the difference.[4] These facts were strongly in the minds of many servicemen after World War I. While the doughboys were waiting to be shipped home, the American Expeditionary Force in Europe provided educational facilities for the servicemen and they were able to take high-school courses, university courses and specialized vocational training. According to General Pershing:

> . . .The total attendance in the organized school system of the American Expeditionary Forces was 230,020, of which number 181,475 attended post schools, 27,250 educational centers, 8,528 the American Expeditionary Forces university at Beaune, 367 art training centers, 4,144 mechanical trade schools, 6,300 French and 1,956 British universities. The attendance upon the institute short courses totaled 690,000 more, and at extension lectures 750,000, giving a grand total of attendance at all educational formations of 1,670,020.[5]

When the veterans returned home their major organization, the American Legion, sponsored a Congressional bill in 1919 that would have granted them *inter alia* financial aid for obtaining vocational training. However, this provision was dropped from the law that Congress finally enacted.[6] The Federal Government did grant rehabilitation training funds for the disabled, however.

While rejecting financial support to veterans for education, the Federal Government sponsored valuable non-financial aid. At wars end the Commissioner of Education was instrumental in obtaining agreements from over 78 of the top universities of the country, including the University of Wisconsin, to admit veterans who had not graduated from high school, if they gave evidence of being able to pursue a college career. The Bureau of Education was also instrumental in having practically all of the agricultural colleges in the country offer training during their summer sessions to veterans free of charge.[7]

Several of the States felt that this was not sufficient and stepped into the Federal vacuum. They ended up giving veterans of their States a total of $ 7,553,221 in direct educational benefits. Excluded from this sum is free tuition granted veterans by many states to its schools, colleges and universities.[8] Those States providing the major "doughboy" programs were:

California--Gave a maximum education bonus of $1,000. 1,400 veterans received funds for furthering their education of $500,000.
Colorado--Loaned $200 to veterans for completing their education.
Illinois--Scholarships to a State normal university, teachers college or to the University of Illinois were given; the veterans could also enroll in extension courses offered by those institutions without the payment of tuition fees.
Indiana--The veterans' welfare associations maintained schools for the education of needy veterans, their widows and orphans; free tuition was given to children of wounded, gassed or disabled veterans.
Kentucky--Free scholarships to the higher educational institutions of the State were granted.
Minnesota--Tuition credits not to exceed $200 total to each veteran were authorized.
New York--Tuition credit not exceeding $100 per year and an additional $100 for maintenance were given. Participating veterans were chosen by competitive examination.
North Dakota--Granted $25 for each month of service to the veteran to either complete his education or purchase a new home.
Oregon--An education bonus of $25 a month, not to exceed $200 a year for four years was provided veterans.
Wisconsin--An education bonus of a maximum $1,080.00 and free extension courses were granted.

This was the backgound in which the Wisconsin bill found its genesis.

WISCONSIN'S EDUCATIONAL BONUS

Wisconsin World War I veterans were first granted a cash bonus of $10 a month for each month of service, with a minimum $50 payment by the Wisconsin Legislature. While many people felt that this payment was more than generous, others strove for a "more fitting gift." In the words of Dr. Edward A. Fitzpatrick, Secretary of the State Board of Education:

> The cash bonus did not satisfy the idealism of America or Wisconsin. The idea of giving the soldiers and sailors, as an expression of gratitude of the state, further educational opportunity is a conception worthy a democracy. It is in keeping with the great public service which these men rendered or were ready to render to this nation. And the state in making such an offer to the soldier, is serving well its own purpose of promoting the common welfare. Nothing can improve the state more than a general increase in the

> intelligence and information of its citizenship. Such a result is to the state immediately and ultimately of greater value than any material advancement that could come to it. In the idea of an educational bonus for those who served the country during the recent war the interests of the individual and state are one, and it is peculiarly fitting that the gift the state should give to those men is further educational opportunity.[10]

The governor of the state also supported an educational bonus as a ". . . gift that the soldier can neither lose nor squander; one that will be helpful to him during the remainder of his life."[11]

Unfortunately, the State Legislature of Wisconsin does not keep a journal of its debates. The history of the Education Bonus had therefore to be pieced together from newspaper and magazine articles of the time. They paint a very interesting picture and one that was repeated in most of the other states that offered the servicemen bonuses in the form of continued education.

The 1919 session of the Wisconsin Legislature sought for five months to find a suitable method of providing educational opportunities for its servicemen. It was first proposed to ask for voluntary contributions to a fund for paying a bonus, but this was rejected on the grounds that it would be too much like putting the soldier in the position of a beggar.

The concept then evolved that servicemen and women had suffered a distinct financial hardship by serving with the military, and that those who had remained at home and who had profited from "war-swollen profits" should at least share some of the financial burden of the returned serviceman. It was finally decided therefore to pay the veterans a bonus "as a matter of right and justice," and to obtain the money from a scheme of taxation.[12]

The cash bonus was given to those who would not or could not take advantage of further schooling, and a larger amount was given as an education bonus for those who could. These two bonuses were the first of several aspects of the bill that were unusually well-planned and executed. Thus, all veterans received some payment, with the cash bonus discouraging veterans from going to school merely to collect the money (as was to happen in the Federal GI bills), and at the same time providing an incentive for those who could benefit from further schooling to go on to receive the full amount of the bonus.

The Governor, however, felt compelled to veto the bill in the form that it passed the Legislature.

He was mainly opposed to the fact that the education bill would only prove efficacious for those who possessed the necessary qualifications for entrance into the institution of their choice. The others would not be able to take advantage of the bill. He felt that this was "class legislation within the maning of our Constitution," and that it was "wrong in principle because it does not offer equal opportunities to the men who have rendered a like service." He recommended the establishment of special schools for the veterans so that they could make up for their missed education without sitting in the classroom with "children." He finally proposed that action on a new bill remain pending while the veterans were canvassed to ascertain their own desires.[13]

In response to the Governor's instructions, the Adjutant General sent questionnaires to 81,933 of the 118,000 Wisconsin servicemen eligible for the benefits of the bill. 7,222 veterans declared that they would continue their education under the provisions of the proposed bill, and the Adjutant General reported to the Governor the following figures:[13]

Veteran's Preferences

To the University of Wisconsin	2,826
To Special Schools	3,138
To Normal Schools (Teacher's Colleges)	320
To Stout Institute	79
To the Wisconsin Mining School	57
To the S.A.T.C. or Other Private Colleges	802
Total	7,222

It is interesting to note that when the benefits of the bill were finally exhausted, some 7,498 veterans had taken advantage of them.

The Governor recalled the State Legislature for a special session on September 4, 1919 to reconsider the bill. In his opening address he reiterated the reasons for his veto of the previous bill, submitted the results of the questionnaire, and outlined the general principles which he believed the legislators should follow.

The revised bill passed the Legislature by a vote of 28 to 1 without debate in the State Senate, and 69 to 22 in the Assembly, where an unsuccessful bid to kill the bill was made. It was published and became law on September 11, 1919.[14]

The bill made seven important provisions:

1) The veteran would receive $30 per month for each month that he was in regular full-time attendance at an approved educational institute.

2) The Extension Division of the University of Wisconsin would provide free tuition for all correspondence courses.

3) Special schools would be established to meet the special needs of the veterans.

4) Free evening classes would be provided in any locality of the State where there was adequate demand.

5) A scheme of taxation to pay for the bill's provisions was authorized.

6) The bill specifically provided that it was to be liberally interpreted.

7) Profit-making schools were expressly prohibited.

A further provision was that the State Board of Education was to assign veterans to schools of its choice. This provision was made so that a housing shortage could be forestalled by spreading veterans among all eligible State institutions, and to ease the problem of providing adequate facilities and staff.[15] Existing facilities prooved adequate, however, and the Board was able in practically every case to assign the veteran to the school of his own choice.

When the bill was passed, the Secretary of the Board of Education immediately issued a stirring challenge to the veterans of the state:

> The people of the State voted you $15,000,000 to be distributed on the basis of your length of service for a bonus as an expression of its gratitude for a great service nobly done.
>
> The State, through the Special Session of the Legislature, has done even a greater thing. It provides the opportunity for an education suited to your needs. To make possible such an education, it offers you a bonus of $30 a month while in regular attendance at an educational institution. The bonus granted by the State cannot possibly cover all the expenses of your education. The offer of the State, is, in fact, a call for a new public duty; for a further investment of your time and your money to fit youself to become even a better citizen, and to render in peace time the quality of service you rendered in war.
>
> War calls for great personal sacrifice in the interest of the common welfare. No less does peace. And the call to duty and service and sacrifice is not less insistent, not less imperative, not less necessary than the call of war, and it requires the same high personal qualities.
>
> By virtue of the crisis that brings on war, its call is splendidly answered, and the great virtue of patriotism furnishes the motive. Peace, unfortunately, does not have the advantage ordinarily of the great emotional power of crises. It has no special appeal. It must rely on a clear sense of public duty without any of the social pressure that war commands. The welfare of the nation, the safety of our democracy depends upon such a sense of public duty.[16]

This call to a Holy War in the cause of the State quickly received a rather rude jolt. The funds, which were promised to be available on November 1, were frozen by an announcement from the Secretary of the Treasury's office on October 21 that the payments would be withheld until the State Supreme Court acted on the bill's constitutionality.[17] University of Wisconsin officials feared that over half the bonus veterans attending the university would have to withdraw from school for lack of funds, as 304 veterans attending the university petitioned to be made co-defendants in the case.[18]

The opponents of the bill had previously forced the Attorney General to render an opinion regarding its constitutionality. His opinion was favorable and he refused to submit it to the Supreme Court. In a last-ditch effort they then had a taxpayer bring "friendly suit" against the State. The taxpayer was a State employee, represented by an attorney appointed by the Governor and paid for by the State.[19]

Press reaction became rather vitriolic, and is well-illustrated by rather amazing statements made by the Attorney General, John J. Blaine:

> It was this surtax that caused the most painful apprehensio in the minds of the war profiteers, first, because it applied to the incomes of the year 1918 and second, because it was a distinct recognition of the economic principles of taxation that those best able to pay should bear the largest share of the burdens of government. . . . Thus it came to pass that the men with excessive war incomes had their necks in the yoke when it came to paying the soldiers' bonus. They thereupon resorted to the protection of the constitutions, state and nation, of the sacred rights of property. These are perilous times, and the profiteers did not wish to disclose their vulnerable persons. They might want these soldier boys to protect their property in the future,[20] and it was necessary to camouflage their attacks on the laws.

Again, quoting from a Capital Times article:

> This 'friendly' suit is not brought by a poor capital employee. He is not the real party in interest. The real party plaintiff is the same skulking crew that remained at home and

> fed fat off the government while the boys were fighting in the field. . . . Indeed! the governor opposed the surtax on incomes when the bill was before the legislature. Here is a real grievance for men with swollen fortunes. Well--we are mighty sorry for some of these real fellows who are trying to make both ends meet and don't know where the meal ticket is coming from while this friendly suit is pending. It's hell, boys, but in the words of your war governor don't 'feel in the least alarmed.' Your empty stomach won't hurt the profiteers any. So why should you care. . . .The governor knows full well that this suit is forced by undisclosed interests.[21]

Another article of the Capital Times thought it knew who some of those undisclosed interests were:

> Mr. Johnson (the State Treasurer) knows that Mr. Butler is the attorney for the Gisholt Co. which made millions out of the war and which fought every attempt made to saddle a larger part of the expense of the war on those who made money out of it. Mr. Johnson knows that Mr. Butler is the attorney for the gas company and the telephone company and that he is a favorite attorney of the big interests of this state,--the interests that are really back of this fight. . ..Mr. Johnson knows that this suit has been started because the big interests of the state do not want to pay this increased tax. He knows that many of these profiteers who walked out in front of the procession to the depot when these boys were being sent to war now balk when it comes to giving up a little of the blood money which they made while the boys were away.[22]

THE WISCONSIN SUPREME COURT DECISION

The suit was the most important case in point of the amount involved ($25,000,000) that had come before the State Supreme Court up to that time.

Judge Vinje rendered the decision of the court on February 10, 1920. The judge addressed himself to the constitutional arguments against giving an individual a bonus to further his education. In his words (but in slightly different arrangement):

> It is urged that the act in question is void because (a) the money levied by it from the taxpayers of the state is not to be spent for a public or governmental purpose, (b) a state debt is incurred contrary to the provisions of Sections 3 and 4 Art. VIII of the Constitution, and (c) it gives financial aid to religious schools.

His rebuttal against each of these points in turn may be summarized as:

> a) Its purpose is not to make the soldier financially whole but to express gratitude and stimulate love of country in those that give, in those that receive and in the public at large--to the end that an impressive objective lesson in patriotism may be engraved in the hearts of all. . . . Since it is the duty of government to maintain domestic tranquillity, and since that can successfully be done only by the patriotic devotion of its citizens, the stimulation of patriotism becomes a public or governmental function. . . . If, as held in the cash bonus case, the giving of money to soldiers, which they may spend as they choose, is a public purpose, much more so must be the giving to them of an education. A free government's best guaranty of continuity and security lies in the enlightenment of its people. This is true both in time of peace and in time of war. The proved efficiency of our soldiers was in a large measure due to their excellent education, both technical and general; in their power of initiative, and in their willingness and ability to assume personal responsibility whenever the occasion demanded it.
>
> b) The money is levied for the purpose of making a gift--a pure gratuity--revocable at will. The law establishes no contract relation such as can compel its levy. Nor does it create a debt. . . . It is sufficient to hold that the state does not lend its credit or create a debt within the meaning of the constitution by making voluntary lawful gift to a number of its citizens.
>
> c) The contention that financial benefit accrues to religious schools from the act is equally untenable. Only actual increased cost to such schools occasioned by the attendance of beneficiaries is to be reimbursed. They are not enriched by the service they render. Mere reimbursement is not aid. Dorner v. School District, 137 Wis. 147.[23]

The latter decision was in much the same vein as the U.S. Supreme Court decision in 1963 regarding compulsory Bible reading in public schools: "To withstand the strictures of the Establishment Clause there must be a secular legislative purpose and a primary effect that neither advances nor inhibits religion."[24]

The Court thus upheld the constitutionality of the bill, the opponents were finally defeated, and the veterans found themselves with a financial inducement to obtain further education.

ANALYSIS OF THE SUBSTANTIVE ASPECTS OF THE BILL

1) Education Bonus--There was in the Wisconsin bill the strong element of attempting to make up to the veteran those things which he had lost out on while in the service in comparison to those who had remained at home. This concept was to become the guiding

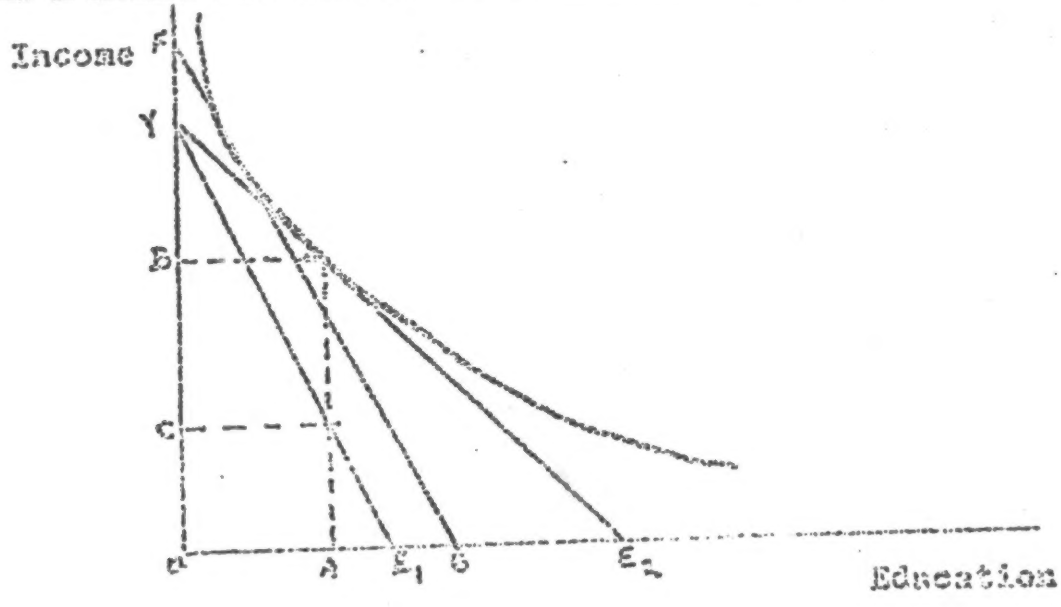
principle twenty-five years later of the Federal GI bills. Wisconsin tried three programs to help the veteran shift to the same subjective position as he was before he went into service regarding his decision to obtain further education. These programs were: 1) dropping the requirement that a high school diploma be the prerequisite for attending college, if the veteran were capable of college level work, 2) the State Board of Education undertook to convince the veteran that the advantages of further education were greater than the disadvantages entailed and 3) the State paid an educational bonus with the intent that the subsidy would overcome the disutility of further schooling in so far as funds were concerned. The State did not attempt to pay for the full costs of schooling (the average cost of attending the University of Wisconsin in 1929 for example was approximately $575 per school year).[25] but the $270 State payment [illegible] was approximately one-half the direct costs involved.

?

The implicit economic reasoning behind the bonus can be illustrated by the use of indifference curve analysis.[26]

Figure 1

Effect of A Bonus Payment On An Individual's Demand for Education



In figure 1, the veteran's income is measured on the vertical axis, and the amount of education which this income could purchase if the entire amount were spent on education is measured on the horizontal axis. The line YE_1 then represents the veteran's budget line, since it shows how he can distribute his income between education and cash. The education bonus given to the veteran by the State reduced the cost of a college education to him by approximately one-half, so we can draw a new budget line where OE_2 is approximately twice that of OE_1. The veteran will now be in equilibrium when he obtains OA of education, which is the amount indicated by the tangency of his indifference curve with the budget line YE_2. The amount of bonus which he would receive for time period t, would be BC dollars. This is so, since the veteran would spend YB on education. If he had not received the bonus payment but had purchased the same amount of education, he would have had to spend YC. Hence, the cost to the State of Wisconsin for the bonus would be BC, the vertical distance between the two budget lines. From the veteran's viewpoint, he would have been better off if he had just received the money without also having to spend it on education. This can be illustrated by moving the budget line OE_1 (the pre-bonus budget line) until it becomes tangent to the indifference curve, which would make him just as well off as he was with the bonus. This yeilds the line FG, and it can clearly be seen that FY, which is the amount of money that would have made him as well off as he was after getting the bonus, is less than the line BC, the cost of the bonus to the State. Thus the cost of giving the education bonus to the veteran was greater than the monetary equivalent of the subjective gain to the veteran. This can be turned around to state that the education bonus caused the veteran taking advantage of it to obtain more education than he would have done if the cash equivalent of the education bonus had been handed to him.

2) Correspondence Courses--In an effort to be of value to everyone, the Education Bonus Bill provided that those who did not take advantage of the full-time education provisions of the bill could take correspondence courses free of tuition charges from the University Extension Division. Over 425 separate courses of instruction were offered by the university. The veteran had to purchase his own text books, lboratory material, supplies, paper, postage, etc. He was required to pay for these items since it was felt that if he had to put some money into the course, he was more likely to undertake the work seriously, and to aim it toward some goal. This requirement was changed in 1939 to cover the full costs of the course.

The one proviso was that only one course could be taken at a time. There was no limit on the total number of courses that could be taken, nor has this benefit terminated.

In 1920, 2,352 veterans had received permission to take correspondence courses, but only 1,072 were actually working on them.[27] In 1914, 1,114 World War I veterans were still taking these courses.[28]

The problem with the correspondence courses was that many veterans took them only to occupy their time during a period of unemployment and dropped the course as soon as they obtained a job.[29] The same problem was to be experienced in relation to World War II veterans taking correspondence courses. It was estimated that only 10,7% of the veterans completed the correspondence courses which they had elected.[30]

Business courses such as book-keeping, accounting, business law, banking, selling, etc., proved to be the most popular courses taken by the World War I veterans.

3 and 4) Special Classes and Schools--Special academic, vocational or other part-time day or evening classes could be organized upon the petition of at least fifteen eligible persons. Typical courses offered under this provision were commercial law, accounting principles, corporate organization and finance, commercial law, shop mathematics, shop drawing, etc. Again business courses were favored.

The formation of the Milwaukee Campus of the University of Wisconsin in 1919 was a direct result of these provisions of the bill.[31] Over 80 students elected to take engineering and commerce courses in Milwaukee from the Extension Division of the University that first year. The campus was established at that time and it has since grown to 14,176 students.

5) Financing the Bill--The bill authorized the State to raise the funds to pay for the education bonus by two taxes:

a) A surtax on personal and corporate income, in addition to the existing level, which was to be levied annually for five years, and

b) If the above proved insufficient in any year, then a tax was to be levied on the assessed dollar valuation of the State, the exact mill rate required to cover the deficit was to be determined by the State Emergency Board.

The tax rates started at four-tenths of one percent on all personal taxable income over $3,000 and increased one-tenth of one percent for each thousand dollars, or part thereof, up to twelve thousand dollars. Anything in excess of twelve thousand dollars was taxed at a flat one and two-tenths percent rate.

Corporations, joint-stock companies and associations were taxed five-tenths of one percent on the first one thousand dollars of taxable income with the rate increasing one-tenth of a percent on each thousand dollars up to seven thousand dollars. Taxable income in excess of seven thousand dollars was then taxed at a flat one and two-tenths per cent. The law allowed these enterprises to deduct 6% of the value of their capital stock surplus and undivided profits befor applying the surtax to their taxable income.

The surtax on income was sufficient to cover all expenses, so the State did not have to resort to the property tax levy to finance the bill.[32] Wisconsin, along with the rest of the nation, experienced an unusual prosperity for a decade after the war. Corporate income in the State increased 193.5% (while the average U.S. increase was only 107%) and wages in manufacturing industries also experienced a sizeable increase.[33] The surtax on these growing incomes sufficed to cover all of the bill's expenses.

Other States had financed their veteran's educational bonuses by means of increased property tax levies, or by selling bonds, which, in most instances, eventually fell on the property holder.

Professor Harold Groves has severely criticized the practice of relying on regressive property taxes to support education. Among other reasons for his condemnation is the logical inconsistancy of financing a project which is so closely allied to economic growth and personal income as education, by a tax whose yields are not directly related to education.[34]

Once more, the framer's of Wisconsin's education bonus showed unusual foresight.

6) Liberal Interpretation of the Bill--A great deal of the bill's success must be attributed to the proviso that it be liberally construed, as it directed the State Board of Education to confer its benefits upon all persons who in its opinion came within the spirit and purpose of the bill.

One of the first tests came in the question of out-of-state school assignments. The Board rose to the occassion and assigned veterans to out-of-state institutions if they had already entered them and transferring would have resulted in loss of credits. Graduate students who had begun their work out of State and who had their doctoral dissertations underway, seniors in out-of-state institutions, veterans who had enrolled between September and October 1919 without knowing about the bonus, and all those veterans where State institutions were unable to provide the required training program were allowed to attend out-of-state institutions. In 1919 261 bonus veterans were assigned to institutions in 26 States. The University of Minnesota received 31 bonus veterans, 20 went to Northwestern, 19 to the University of Chicago, 18 to Mooseheart School Illinois, 15 to Harvard University and 13 to the Palmer School of Chiropractic, Iowa. The remaining out-of-state institutions had 8 or less veterans assigned.[35] By 1922 the number of these assignments had grown to 1,609 veterans in 218 institutions located throughout the United States. Veterans had also been assigned to three different universities in France, two in England, one in Norway, one in Belgium, and one in Japan.[36]

Residence requirements were also construed very liberally.

7) Exclusion of Profit Schools--Schools run for profit were prohibited from participating in the educational bonus program. This provision was again apparently a wise one. The U.S. Federal Veteran's Administrator stated that most of the problems encountered in the World War II GI bill grew out of private profit educational institutions. Individuals sensing quick profits set up what could only be termed "fly-by night outfits." It was estimated in January 1951 that only 20 percent of the 1,677,000 veterans who had attended

to the veteran of the additional schooling which he obtained as a result of the education bonus.

One might claim, as has been done for the GI bill, that it did not take the World War I veteran long to repay the State in the form of higher tax payments on his greater income for the bonus which he had received. While this might very well be true, it must be kept in mind that the bonus was a transfer payment and the State might have reaped greater returns had the funds been left in the hands of their original owners or had been invested in some other project.

It has been demonstrated that there is a transmission effect on the level of the parent's education to that of their children. According to Brazer and David, "The transmission levels of education from parents to children is impressive. If educational attainments are classified into three broad groups--grade school or less, some high school or high school diploma, and at least some college--then almost three-fifths of spending unit heads report that they are in the same group as their fathers."[42] Thus, one would expect that the State also has received an unexpected dividend in the form of higher educational attainments of those children whose fathers were induced to undertake further education by the education bonus.

SUMMARY

The legislators considering the GI bill in 1944 actually had a wealth of material they could have drawn upon regarding payments to veterans as an incentive to increase their educational attainments--the Wisconsin "doughboy bill." When the legislators met to consider the Korean GI bill, they carefully examined the weaknesses of the World War II bill and, in correcting them, ended up with a bill whose education section resembled the Wisconsin bill in most profit schools had completed their courses and that much of the training received was of poor quality.[37]

CHARACTER OF WORK PERFORMED

Opponents of the bill had prophesied at first that the veterans would not be able to settle down to a quiet life of studying after coming in fresh from the camp and battlefield. However, as was the case after World War II, the transition was made quickly, and the veteran, on the average, became a better student than his non-veteran contemporaries.[38] This information would have greatly relieved the minds of many people had it been made available during the debates on the GI bill in 1944.

RESULTS OF THE BILL

The formal education of the majority of Americans in the same generation as World War I veterans ended before they even reached high school.[39] To the extent that the veteran was induced by the bonus to obtain further schooling, he was that much better prepared to meet the competition of an increasingly higher educated labor force. Between 1900 and 1957 the average years of schooling of the labor force increased 6 1/3 times on a 1940 equivalent basis.[40] This increased education yielded high returns in higher wages and salaries to those who obtained it. According to Miller's figures of income in relation to education, those 45 to 54 years of age in 1939 who had finished high school were earning 30% more than those who had attended high school but had not graduated, and 88% more than those who had received some elementary schooling; while college graduates were earning 58% more than high school graduates.[41] These figures are subject to the limitations mentioned by Miller, but are sufficiently accurate to illustrate the value substantive aspects.

The Wisconsin bill paid veterans $30 a month during the period that they were enrolled in an approved course of study. 7,498 veterans were paid a total of $4,672,064 (or an average of $609), which was approximately half the total value paid by all States to World War I veterans. While this amount may seem small compared to the Federal Bills, in 1919 over one-half of all male students attending the University of Wisconsin were receiving these benefits.

One feature of this bill that was different from the Federal bills was the payment of a bonus to those veterans unable to take advantage of the education opportunity offered. This allowed all veterans to receive some benefit for their rehabilitation, and at the same time discouraged veterans from enrolling in institutions merely to capture the education bonus.

In addition to the bonus, the bill authorized free University of Wisconsin correspondence courses; provided for the establishment of special schools and evening courses, a provision which resulted in the establishment of the Milwaukee Campus of the University of Wisconsin which now enrolls over 14,000 students; the funds for these activities came from a scheme of graduated income taxation, which was better designed to capture some of the benefits yeilded by the education bonus that the regressive property taxes which were the basis of the aid of other States; veterans were allowed in certain cases to attend schools outside the State and even in foreign countries; and finally, it prohibited payments to profit making institutions to discourage the creation of fly-by-night outfits and to forestall competitive attempts to induce veterans to attend particular institutions.

The bill was well-conceived, coordinated and supervised, and as far as is known, did not lay itself open to charges of abuse and scandal, which were a feature of the original Federal GI bill.